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1899-1901
no. 17-19

United States
Department of Agriculture. Division of
Agrostology.

Bulletin
17- 19.

MO. BOT. GARDEN
1911

Washington
1899- 1901.

BULLETIN No. 17. (Revised edition.) (Agros. 80.)

U. S. DEPARTMENT OF AGRICULTURE,

DIVISION OF AGROSTOLOGY.

[Grass and Forage Plant Investigations.]

AMERICAN GRASSES—II.

(ILLUSTRATED.)

BY

F. LAMSON-SCRIBNER,
AGROSTOLOGIST.

WASHINGTON:
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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Division of Agrostology,
Washington, D. C., January 5, 1901.

Sir: I have the honor to transmit herewith copy for a revised edition of American Grasses—II, Bulletin No. 17 of this Division, and I respectfully recommend its early publication. The first edition of this work was quickly exhausted, and there are frequent applications for copies which it is impossible to supply; a new edition is necessary to meet this demand. American Grasses—I was published as Bulletin No. 7 of the Division of Agrostology, and contains descriptions and illustrations of 302 species. Three revisions of that work have been published. In this bulletin 325 additional species are described and illustrated, making a total for the two bulletins of 627 species. In this revision the synonymy has been carefully gone over and revised or extended, and the same is true of the descriptions, which have been entirely rewritten. This has been made possible by the adoption of the present form and the use of smaller type, permitting more ample descriptions, which have been deemed necessary, and the occasional addition of economic notes. Many of the illustrations are drawn from type specimens. This is especially true of the new species of *Panicum*. For information concerning the forage or other economic values of the grasses described, the reader is

referred to previously published bulletins of the Division, and especially to Bulletin No. 14. The illustrations are of the same character as in American Grasses—I, and have been executed by the same artists.

Respectfully,

F. LAMSON-SCRIBNER,
Agrostologist.

Hon. JAMES WILSON,
Secretary of Agriculture.

DESCRIPTION OF THE SPECIES.

METRIC MEASUREMENTS AND THEIR ENGLISH EQUIVALENTS.

The metric system adopted in this bulletin is now quite generally employed in botanical and other scientific publications. For those unfamiliar with this system, the English equivalents are added in parentheses, the signs ° for feet, ′ for inches, and ″ for lines or twelfths of an inch being used.

FIG. 303. **IMPERATA BRASILIENSIS** Trin. Mém. Acad. St. Pétersb. VI. Sci. Math. Phys. et Nat. **2**: 331. 1833. (*I. caudata* Chapm. Suppl. Fl. So. U. S. 668. 1884. Not Cyr., or Trin. 1833, or Scribn. 1882.) BRAZILIAN BLADY-GRASS.—A rather slender, erect perennial 3–7 dm. (1°–2½°) high, with narrow, white-hairy panicles, 6–12 cm. (2′–5′) long, and linear-lanceolate leaves. Sheaths lax, glabrous, or those of the innovations pubescent; ligule about 1 mm. (½″) long; leaf-blades 10–30 cm. (4′–12′) long, 4–5 mm. (2″–2½″) wide, glabrous beneath, often pilose on the upper surface and margins below. Spikelets (*a*) linear, about 4 mm. (2″) long, the outer glumes (*b*, *c*) clothed with long hairs from the base to near the middle. Palea (*d*) hyaline, nerveless, glabrous.—Rich, dry soil, southern Florida. (Mexico and South America.) May.

Fig. 304. **ERIANTHUS ALOPECUROIDES** (L.) Nash in Britt. & Br. Illus. Fl. 1: 98. 1896. Not Ell. 1816. (*Andropogon alopecuroides* L. Sp. Pl. 1045. 1753.) FOX-TAIL PLUME-GRASS.—A stout, erect perennial, 2–3 m. (6°–10°) high, with long leaves and hairy panicles 15–30 cm. (9′–12′) long. Sheaths glabrous; leaf-blades usually glabrous, 15–60 cm. (6′–24′) long, 12–24 mm. (6″–12″) wide, sometimes hairy on the upper surface near the base. Spikelets (*a*) 6–7 mm. (3″–3½″) long; empty glumes (*b*, *c*) about 6 mm. (3″) long with few scattered, long, white hairs; the deeply-cleft fourth or flowering glume (*e*) with a stout, twisted awn 14–18 mm. (7″–9″) long; hairs as long as or exceeding the spikelet.—Low moist grounds, New Jersey to South Carolina and westward to Texas. September.

Elliott (Sk. Bot. S. C. and Ga. 1: 38) had a wrong idea of *Andropogon alopecuroides* L., as he described it as having a straight awn. Examination of Baldwin's type of *E. contortus* in Herb. Acad. Nat. Sci. Philadelphia shows that it is distinct from this species.

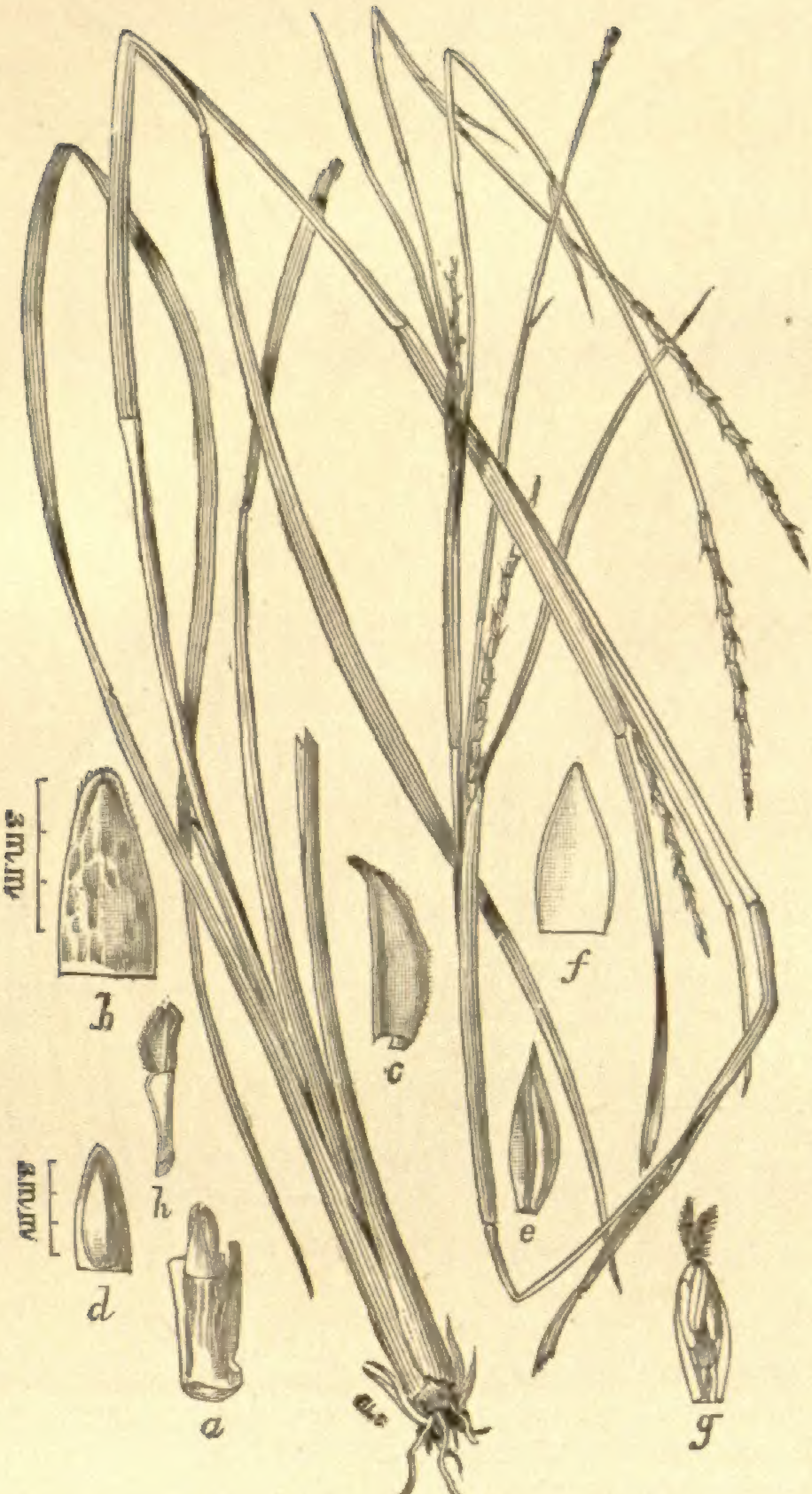

FIG. 305. **MANISURIS TESSELLATA** (Steud.) Scribn. U. S. Dept. Agr., Div. Agros. Bul. **20**: 20. 1900. (*Rottboellia tessellata* Steud. Syn. Pl. Gram. 362. 1854. *Rottbœllia corrugata* of authors, not of Baldwin, Am. Journ. Sci. **1**: 355. 1819.) TALL RAT-TAIL-GRASS.—A stout, erect perennial, 1 m. (3°) or more high, with flattened culms and sheaths, and subcylindrical spike-like racemes, 6–8 cm. (2½′–3¼′) long, terminating the branches from the upper joints of the culm. Sessile spikelets, 5–6 mm. (2½″–3″) long, with transverse ridges and irregular depressions on the back of the first glume (*b*).—Swamps and wet pine barrens, Florida to Mississippi. September, October. In var. AREOLATA (Hack.), which grows in damp pine woods near Mobile, Alabama, the first glume of the sessile spikelet is nearly smooth, the transverse ridges being obsolete.

FIG. 306. **MANISURIS RUGOSA** (Nutt.) Kuntze, Rev. Gen. Pl. **2**: 780. 1891. (*Rottbællia rugosa* Nutt. Gen. **1**: 84. 1818; *R. corrugata* Baldw. Am. Journ. Sci. **1**: 355. 1819.) ROUGH-FLOWERED RAT-TAIL-GRASS.—A rather stout perennial, with compressed culms 1–2 m. (3°–6°) high, narrow leaves 30–50 cm. (12′–20′) long, and slender terminal and axillary racemes 4–5 cm. (1½′–2′) long. Outer glume of the sessile spikelet (*a*) about 4 mm. (2″) long and strongly transversely rugose.—In moist or wet soil from Delaware to Florida and Alabama and westward to Texas, chiefly near the coast. August to October. Var. CHAPMANI (Hack.) Scribn., which occurs in Florida, has much less rugose outer glumes, shorter internodes of the inflorescence, and elongated slender flowering branches.

Manisuris rugosa (Nutt.) Kuntze, and *Manisuris corrugata* (Baldw.) Kuntze, are identical, as shown by the type specimens in the Herb. Acad. Nat. Sci. Philadelphia, and Baldwin himself declares them to be the same and to have been described from the same material. The grass referred to *M. corrugata* in recent collections is *M. tessellata* (Steud.) Scribn. (Fig. 305.)

FIG. 307. **MANISURIS CYLINDRICA** (Michx.) Kuntze. Rev. Gen. Pl. **2**: 779. 1891. (*Tripsacum cylindricum* Michx. Fl. Bor. Am. **1**: 60. 1803; *Rottbœllia cylindrica* Torr. Pac. R. R. Rept. **4**[5]: 103. 1857.) SLENDER RAT-TAIL GRASS.—A slender perennial, with nearly terete, erect culms 6–9 dm. (2°–3°) high, narrow leaves 15–30 cm. (6′–12′) long, and cylindrical, spike-like racemes 12–18 cm. (5′–7′) long. Sheaths smooth; ligule short, ciliolate; leaf-blades 2–3 mm. (1″–1½″) broad, smooth beneath, scabrous above and on the margins. First glume (*c*) of the sessile spikelet 7-nerved, obtuse, concave, with slight pits on the outside. Pedicellate spikelet rudimentary, 1.5–2 mm. (¾″–1″) long. Sessile spikelet (*b*) 6–7 mm. (3″–3½″) long.—Prairies, Florida to Arkansas, Oklahoma, Indian Territory, and Texas. June to September.

FIG. 308. **ELIONURUS TRIPSACOIDES** Humb. et Bonpl. in Willd. Sp. Pl. **4**: 941. 1805. (*Rottbœllia ciliata* Nutt. Gen. **1**: 83. 1818.) FALSE TRIPSACUM.—A stout, branching perennial 7–12 dm. (2½°–4°) high, with narrow leaves 15–50 cm. (6′–20′) long and slender, more or less pilose racemes 8–14 cm. (3′–6′) in length. Sessile spikelets lanceolate, 7–10 mm. (3½″–5″) long, with a short, densely bearded callus 1–1.5 mm. (½″–¾″) long; first glume (*c*) acute, bifid at the apex, scarious on the margins; second and third glumes (*d*, *d′*) subequal, the former glabrous, the latter ciliate; pedicellate spikelets 4–7 mm. (2″–3½″) long.—Low pine barrens and marshy grounds, Florida to Texas. (South America.) **August, September.**

FIG. 309. **ANDROPOGON TENER** Kunth, Rev. Gram. **2**: 565. 1835. BEARDLESS BROOM SEDGE.—A slender perennial grass 2–6 dm. ($\frac{2}{3}$°–2°) high, with long, narrow leaves and very slender racemes 3–6 cm. (1¼′–2¼′) long. Sheaths equaling or exceeding the internodes; ligule very short, truncate; leaf-blades 5–15 cm. (2′–6′) long, 1–2 mm. (½″–1″) wide. Sessile spikelet (*a*) 4–5 mm. (2″–2½″) long, with the ciliate and deeply-cleft fourth glume (*f*) bearing a slender awn 8–14 mm. (4″–7″) long. The first, second, and third glumes are shown by *c*, *d*, *e*, respectively, the palea by *g*, and the lodicules by *h*. Pedicellate spikelet (*b*) about equaling the sessile one, consisting of four empty glumes.—Dry, sandy hills and pine barrens, Florida, Alabama, and Mississippi to New Mexico. (Cuba, Mexico.) July to September.

FIG. 310. **ANDROPOGON SEMIBERBIS** Kunth, Enum. **1**: 489. 1833. SHORT-BEARDED BROOM SEDGE.—A rather stout, cæspitose perennial 6–10 dm. (2°–3½°) high, with narrow leaves and slender racemes 8–12 cm. (3′–5′) long. Leaf-blades 15–30 cm. (6′–12′) long, 2–4 mm. (1″–2″) wide, sometimes subvillous at the base. Sessile spikelet (*a*) 7–8 mm. (3½″–4″) long, with the slender awn of the deeply cleft fourth glume (*e*) 10–16 mm. (5″–8″) long. The first, second, and third glumes are shown by *b*, *c*, *d*.—Florida to New Mexico and Nevada. (Cuba, Porto Rico.) **September to April.**

Var. PRUINATUS Hack. in DC. Monog. Phan. **6**: 370. 1889. (*A. tener* Curtiss N. A. Pl. 3633, not Kunth), has the nodes and under surface of the leaves pruinose. Florida.

FIG. 311. **ANDROPOGON HIRTIFLORUS OLIGOSTACHYUS** (Chapm.) Hack. in DC. Monog. Phan. **6**: 372. 1889. (*Andropogon oligostachyus* Chapm. Fl. So. U. S. 581. 1860.)—A slender perennial 6–12 dm. (2°–4°) high, with narrow, smooth, glaucous leaves and slender racemes 5–6 cm. (2′–2½′) long. Sessile spikelet (*a*) 6–7 mm. (3″–3½″) long, with the first glume (*b*) hirsute and the deeply cleft fourth glume (*c*) bearing a slender geniculate awn about 15 mm. (7½″) long. The second and third glumes are shown by *d*, *e*, and the lodicules by *f*. Florida, Arizona. (Santo Domingo and Mexico.) July to September.

Var. FEENSIS (Fourn.) Hack. l. c. A form with the leaf-blades slightly scabrous on both sides; sheaths pilose above, ciliate, the first glume pilose and roughened. New Mexico. (Mexico.)

FIG. 312. **ANDROPOGON GRACILIS** Spreng. Syst. 1:284. 1825. Not Presl. 1830. SLENDER BROOM SEDGE.—A slender, erect perennial 3–4 dm. (12′–16′) high, with thread-like leaves 10–20 cm. (4′–8′) long and terminal, silky-hairy racemes 3–5 cm. (1¼′–2′) long. Sessile spikelet (*a*) 4–6 mm. (2″–3″) long, with the awn of the flowering glume (*e*) 13–19 mm. (6½″–9½″) long. The first, second, and third glumes are shown by *b*, *c*, *d*, and the lodicules by *f*. Pedicellate spikelet (shown in *a*) linear-subulate, 1.5–2 mm. (¾″–1″) long; pedicel (shown to the right in *a*) densely plumose-ciliate, with white hairs one and a half times as long as the pedicel, which about equals the sessile spikelet.—Dry pine woods, southern Florida. (West Indies.) June to August.

FIG. 313. **ANDROPOGON VIRGINICUS TETRASTACHYS** (Ell.) Hack. in DC. Monog. Phan. **6**: 411. 1889. (*A. tetrastachys* Ell. Sk. Bot. S. C. and Ga. **1**: 150, *pl. 8. f. 4.* 1817; *A. curtissianum* Steud.) MANY-FLOWERED BROOM SEDGE.—A tall, slender variety, with the leaf-sheaths often villous above and the lower leaves very villous. Panicles 30–50 cm. (12′–18′) long: sessile spikelets (*a*) 4–4.5 mm. (2″–2¼″) long: awns 16–20 mm. (8″–10″) long.—Moist pine barrens and old fields, Florida, Alabama to Mississippi. September, October.

Var. VIRIDIS Hack, l. c., has green glabrous leaves and very smooth panicle branches: var. GLAUCUS Hack. l. c., has smooth, purplish leaves, pruinose sheaths and culms, smooth panicle branches and nodes: var. DEALBATUS Mohr, l. c., is a form with the lower leaves and sheaths strongly pruinose and the panicle-branches bearded at the nodes. (See also Bul. **7**: 16 *fig. 10.*)

FIG. 314. **ANDROPOGON MOHRII** Hack. in Contr. U. S. Nat. Herb. **3**: 11. 1892. (*A. liebmanni mohrii* Hack. in DC. Monog. **Phan. 6: 413. 1889.**) MOHR'S BROOM SEDGE.—A stout, erect perennial 10–15 dm. (3°–5°) high, with densely villous sheaths and leaves and lax panicles 50–60 cm. (18′–24′) long. Sessile spikelets (shown in *a*) about 4 mm. (2″) long, with the narrow fourth glume (*e*) bearing a slender awn about 20 mm. (10″) long. The sessile and pedicellate spikelets are shown by *a*, the first glume by *b*, the second by *c*, the third by *d*, and the broad glabrous lodicules by *f*.—**Low pine barrens, Alabama, Mississippi, and Louisiana. October, November.**

Fig. 315. **ANDROPOGON LONGIBERBIS** Hack. Flora, **68**: 131. 1885. (*A. tetrastachyus* var. *distachyus* Chapm.) LONG-BEARDED BROOM SEDGE.—A slender grass 6–8 dm. (2°–3°) high, with compressed, silky-villous sheaths, comparatively short and narrow leaves, and slender panicles 20–30 cm. (8′–12′) long. Racemes 3 cm. (1¼′) long. Sessile spikelet 4–4.5 mm. (2″–2¼″) long, somewhat broader than in *A. virginicus*, with the shortly 2-toothed fourth glume (*e*) bearing a slender awn about 16 mm. (8″) long; first glume (*b*) acute or scarcely mucronate, scabrous on the keels; second and third glumes (*c*, *d*) acute, glabrous. The sessile and pedicellate spikelets are shown by *a* and the lodicules by *f*.—**High pine lands, Florida.** May, June.

FIG. 316. **ANDROPOGON BRACHYSTACHYS** Chapm. Suppl. Fl. So. U. S. 668. 1884. SHORT-SPIKED BROOM SEDGE.—A stout, erect perennial 12-15 dm. (4°-5°) high, with rather long, very smooth leaves and narrow, much branched panicles 60-70 cm. (24′-28′) long. Racemes in pairs, 1.5-2 cm. (⅗′-1′) long. Sessile spikelet narrow lanceolate, about 5 mm. (2¼″) long, with the first glume (*b*) very acute, entire, caniculate between the scabrous keels; second, third, and fourth glumes (*c, d, e*) ciliate, the fourth glume (*e*) bearing a slender awn 7-8 mm. (3½″-4″) long. The sessile and pedicellate spikelets are shown by *a* and the lodicules by *f*.—Pine barrens, Florida. September, October.

FIG. 317. **ANDROPOGON GLOMERATUS** (Walt.) B. S. P. Prel. Cat. N. Y. 67. 1888. (*Cinna glomerata* Walt. Fl. Car. 39. 1788; *A. macrourus* Michx. 1803.) BROOK-GRASS.—A stout perennial 6–12 dm. (2°–4°) high. Sessile spikelets (*a*) 4 mm. (2''') long. Pedicellate spikelet reduced to a short bract or minute awn, its slender plumose pedicel longer than the sessile spikelet. The sessile and pedicellate spikelets are shown by *a*, the first, second, and third glumes by *b*, *c*, *d*, the fourth or flowering glume by *e*, and the flower by *f*.—Low grounds, New York to Florida, westward to Texas, New Mexico, and Nevada. (Mexico, Lower California, Cuba, and Jamaica.) September to November.

NOTE.—Another form of this species is shown in Bul. 7: 27, *fig. 9*.

FIG. 318. **ANDROPOGON MARITIMUS** Chapm. Suppl. Fl. So. U. S. 668. 1884. (*A. scoparius maritimus* Hack. in DC. Monog. Phan. 6: 385. 1889.) SAND BROOM SEDGE. A rather slender wiry perennial, with numerous abruptly reflexed, rigid, and glabrous leaves 5–10 cm. (2′–4′) long and stout racemes 4–5 cm. (1½′–2′) long. Sessile spikelets 10 mm. (5″) long, with the bifid fourth glume (*e*) bearing an awn about 13 mm. (6½″) long; first glume (*b*) 3–5-nerved, long-attenuate; the second and third glumes are shown by *c* and *d*. Pedicellate spikelets 7–10 mm. (3½″–5″) long, the first glume 7-nerved, short-aristate. The sessile and pedicellate spikelets are shown by *a*, and the stamens of the pedicellate spikelet by *g*.—Sand dunes along the coast, western Florida to Mississippi. September to November.

A good sand binder. Allied to *A. scoparius*, but quite distinct.

FIG. 319. **ANDROPOGON HALLII** Hack. Sitzungsber. Ak. Wiss. Wien, **89**: 127. 1884. COLORADO SAND-GRASS.—A stout, glabrous perennial 4-9 dm. (1°-3°) high or more, with flat leaves 10-20 cm. (4′-8′) in length, and stout racemes which are in pairs or in threes and 5-8 cm. (2′-3¼′) long. Sessile spikelets (*a*) 8-11 mm. (4″-5½″) long, with the first glume (*b*) ciliate along the keels and pilose-hairy toward the apex; second and third glumes (*c*, *d*) equal, 3-nerved, retrorsely ciliate on the infolded margins. The fourth or flowering glume is shown by *e* and the palea by *f*. Awn shorter than the spikelet or wanting.—Dry, sandy soil, North Dakota, Montana, southward to Kansas, Texas, and New Mexico. (Mexico.) July to September.

Var. FLAVEOLUS Hack. l. c., has the joints of the rachis yellow-villous, spikelets 8 mm. (4″) long, awn 2-5 mm. (1″-2½″) long. Var. INCANESCENS Hack. l. c., has the joints of the rachis white-canescent, spikelets 11 mm. (5½″) long, awn as in the preceding. Var. MUTICUS Hack. in DC. Monog. Phan. **6**: 444. 1899, like the preceding, but the fourth glume entire, muticous.

FIG. 320. **ANDROPOGON WRIGHTII** Hack. Flora, **68**: 139. 1885. WRIGHT'S BROOM SEDGE.—A slender, erect perennial 5–8 dm. (1½'–3') high, with long, flat leaves 15–20 cm. (6'–8') long and 3 to 4 digitate or subfastigiate racemes about 4 cm. (1½') long. Sessile spikelet 5.5–6 mm. (2¼''–3'') long, with the very narrow fourth glume (e) bearing a slender awn 12–15 mm. (6''–7½'') long; first glume (b) with narrow infolded margins, 7-nerved, hairs of the callus about one-fifth as long as the glume; second glume (c) 3-nerved, short-ciliate above; third glume (d) obtuse, glabrous. The palea is shown by f and the lodicules by g. Pedicellate spikelet equaling the sessile one, consisting of three glumes. The pedicellate and sessile spikelets are shown in a.—Dry mesas, New Mexico. (Mexico.)

FIG. 321. **ANDROPOGON HALEPENSIS** (Linn.) Brot. Fl. Lusit. **1**: 89. 1804. (*Holcus halepensis* Linn. Sp. Pl. 1047. 1753; *Sorghum halepense* Pers.) JOHNSON GRASS.—A stout, smooth, erect perennial 1-2 m. (3°-6°) high, from strong, creeping rootstocks, with long, flat leaves 1-2 cm. (½'-1') broad, and open panicles 15-30 cm. (6'-12') long. Sessile spikelets 4-5.5 mm. (2''-2¼'') long, becoming dark at maturity; first glume (*c*) coriaceous, slightly pubescent, 5- to 7-nerved, second glume (*d*) similar, the margins inflexed, ciliate, third glume (*e*) membranaceous, faintly 2-nerved; fourth or flowering glume (*f*) one-half shorter than the second, bearing an awn 10-15 mm. (5''-7½'') long. The palea and lodicules are shown by *g* and the pedicellate spikelet by *b*. The sessile and pedicellate spikelets are shown in *a*.—Introduced and cultivated in many of the Southern States for hay. (Southern Europe, Asia, and North Africa.)

Johnson grass is of value as a forage grass in the South, but at the same time it may become one of the worst weeds with which the farmer has to contend, its strong, creeping rootstocks making it very difficult to eradicate.

FIG. 322. **ANDROPOGON CONTORTUS** Linn. Sp. Pl. 1045. 1753. (*Heteropogon contortus* Beauv. in R. & S. Syst. **2**: 836. 1817.) TWISTED BEARD-GRASS.—A stout perennial 3-10 dm. (1°-3½°) high, with rather broad leaves and solitary bearded racemes terminating the culm or its branches. Racemes about 5 cm. (2′) long. Sessile spikelet 9-10 mm. (4½″-5″) long, with a sharp-pointed barbate callus, pubescent; first glume (*c*) firm, convolute; second glume (*d*) narrower, 3-nerved; third glume (*e*) very thin, hyaline; fourth or flowering glume (*f*) hyaline at the base, extended above into a hard, twisted, and bent awn 8-10 cm. (3′-4′) long. Pedicellate spikelets 8-10 mm. (4″-5″) long, outer glumes membranaceous, subequal, the first tuberculate-pilose near the margins toward the apex. The sessile and pedicellate spikelets are shown at *a*, and the pedicellate spikelet opened to show the parts at *b*.—Sandy soil, Texas to Arizona. (Tropical and subtropical countries of both hemispheres.) April to October.

FIG. 323. **ANDROPOGON MELANOCARPUS** Ell. Sk. Bot. S. C. and Ga. **1**: 146. 1817. (*Stipa melanocarpa* Muhl. Gram. 183. 1817; *Heteropogon melanocarpus* Benth. Journ. Linn. Soc. **19**: 71. 1882.) LARGE-FRUITED BEARD-GRASS.—A stout, branching annual with slightly compressed culms 5–20 dm. (1½°–7°) high, and terminal or lateral racemes 4–6 cm. (1½′–2½′) long. Sheaths subcompressed, smooth, the upper ones spathe-like; leaf-blades 15–40 cm. (6′–16′) long, 5–10 mm. (2½″–5″) wide, scabrous. Sessile spikelet (*b*) 7–9 mm. (3½″–4½″) long, with a sharp barbate callus 3 mm. (1½″) long, and a stout, densely-villous awn 8–12 cm. (3′–5′) long. Pedicellate spikelet (*a*) 16–20 mm. (8″–10″) long, 2 to 3 times as large as the sessile one, outer glumes subulate-acuminate pointed.—Fields and roadsides, Florida to Alabama. (Throughout the Tropics.)

FIG. 324. **NAZIA ALIENA** (Spreng.) Scribn. U. S. Dept. Agr. Div. Agros. Bul. **17**: 28, *fig. 322*. 1899. (*Lappago aliena* Spreng. Neue Entd. **3**: 15. 1822; *Tragus occidentalis* Nees; *Nazia racemosa aliena* Scribn. & Smith, U. S. Dept. Agr. Div. Agros. Bul. **4**: 12. 1897.) WESTERN PRICKLE GRASS.—A rather slender and diffusely branching annual 1-3 dm. (4'-12') high, with spreading, flat leaves, and slender spike-like racemes 2-8 cm. (1'-3') long. Sheaths loose, striate, shorter than the internodes; leaf-blades 1-3 cm. (½'-1¼') long, 3-5 mm. (1½"-2½") wide, rigid, strongly serrulate-scabrous on the margins, the teeth extending into short hyaline spines; rachis strigose-pubescent. Spikelets in clusters (*a*); first glume minute or wanting; second glume (*b*) rigid, its back covered with rigid hooked spines; flowering glume (*c*) and palea (*d*) hyaline, shorter than the second glume.—Dry, rocky hillsides, Texas, New Mexico, and Arizona. (Mexico, West Indies, and South America.)

FIG. 325. **PASPALUM MUCRONATUM** Muhl. Gram. 96. 1817. (*P. fluitans* Kunth. 1829.) FLOATING WATER-GRASS.—An aquatic perennial, with much-branched, ascending culms from a creeping or floating base, 1.5–9 dm. ($\frac{1}{2}°$–3°) long, and 10 to 50 slender racemes 2–6 cm. (1′–2½′) long. Sheaths lax, smooth, or more or less densely papillate-pilose; ligule short, membranaceous; blades lanceolate, 2.5–15 cm. (1′–6′) long, 6–14 mm. (3″–7″) wide, scabrous. Rachis of the racemes flat, thin, the scabrous margins covering the spikelets and extending beyond them into an acute tip. Spikelets (*b*, *c*) arranged in two rows (*a*), thinly pubescent with minute glandular hairs; outer glumes thin, 2-nerved, the first slightly exceeding the second, which has a brown spot at the base. The flowering glume is shown by *d*, and the palea by *e*.—Southern Illinois to Florida, Louisiana, Indian Territory, and Texas. (Tropical America.) July to October.

FIG. 326. **PASPALUM MEMBRANACEUM** Walt. Fl. Car. 75. 1788. Not Lam. 1791. (*P. walterianum* Schultes.) WALTER'S PASPALUM.—A low, creeping, semiaquatic grass, with much-branched, smooth stems 1.5–4.5 dm. (6′-18′) long, short, flat leaves, and 2 to 6 small racemes 1–5 cm. (½′-2′) long. Sheaths somewhat inflated, smooth; ligule about 2 mm. (1″) long; leaf-blades 1–5 cm. (½′-2′) long, 2–4 mm. (1″-2″) wide, acute, smooth, or scabrous on the margins. Spikelets (*b*, *c*) ovate, obtuse, smooth, about 2 mm. (1″) long, crowded in two rows on one side of the flat rachis (*a*), which is 2–3 mm. (1″-1½″) wide, ciliate-scabrous on the margins; outer glumes 5-nerved; flowering glume (*d*) lenticular, rounded-obtuse, a little shorter than the outer ones. The palea is shown by *e*.—Wet soil, New Jersey and Delaware, south to Florida and westward to **southern Ohio and Texas. (Cuba.) July to October.**

FIG. 327. **PASPALUM BOSCIANUM** Flügge, Monog. 170. 1810. (*P. purpurascens* Ell. 1817; *P. virgatum* Walt., not Linn.) PURPLE PASPALUM.—A stout perennial, with ascending, branching culms 6–9 dm. (2°–3°) high, long, flat leaves, and numerous, usually purple-flowered racemes 2–6 cm. (1′–2¼′) long, crowded near the summit of the culm or its branches. Sheaths lax, smooth, longer than the internodes; leaf-blades 15–45 cm. (6′–18′) long, 6–12 mm. (3″–6″) wide, scabrous on the margins. Spikelets (*b*, *c*) glabrous, crowded, 4-seriate (*a*), obovate, obtuse, 2 mm. (1″) long; empty glumes glaucous or brownish, 5-nerved, smooth; flowering glume (*d*) very dark brown, shining, and minutely punctate, as is also the palea (*e*).—Low woodlands and along ditches, North Carolina and Tennessee to Florida, westward to Mississippi and Louisiana. July to September.

FIG. 328. **PASPALUM LARRANYAGAI** Arech. Gram. Urug. 48, *pl.* 2. 1894. (*P. vaseyanum* Scribn. U. S. Dept. Agr. Div. Agros. Bul. **17** : 32, *f.* 328. 1899. *P. virgatum pubiflorum* Vasey, Bul. Torr. Bot. Club, **13** : 167. 1886; not *P. pubiflorum* Rupr. Bul. Acad. Brux. **9** : 237. 1842.) VASEY'S PASPALUM.—A rather stout, erect perennial 9–18 dm. (3°–6°) high, with long, flat, glabrous leaves and 12 to 25 ascending racemes 5–10 cm. (2′–4′) long. Sheaths shorter than the internodes, the lower ones more or less hirsute; ligule short, ciliate; leaf-blades 30–45 cm. (12′–18′) long, 6–8 mm. (3″–4″) wide, scabrous on the margins. Spikelets (*b*, *c*) ovate, 2–2.5 mm. (1″–1¼″) long, the acute outer glumes long-hairy on the margins, the first thinly hairy all over, 3-nerved, slightly exceeding the flowering glume (*d*). The palea is shown by *e*.—Along ditches, roadsides, and in old fields, Louisiana to Texas. South America. July to September.

FIG. 329. **PASPALUM CURTISSIANUM** Steud. Syn. Pl. Gram. **1**: 26. 1854. CURTISS'S PASPALUM.—A coarse, erect perennial 9–18 dm. (3°–6°) high, with the lower sheaths usually densely villous, long, flat leaves, and 3 to 8 spikes 4–10 cm. (1½′–4′) long. Spikelets (*b*, *c*) nearly orbicular in their outline, strongly compressed on the back, about 3 mm. (1⅛″) long, biseriate, as shown by *a*, short-pedicellate. The flowering glume is shown by *d* and the palea and lodicules by *e*.—Damp pine barrens, Florida to Mississippi. July, August. No. 4990, A. H. Curtiss, 1894; and 3865, S. M. Tracy.

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FIG. 330. **PASPALUM LIVIDUM** Trin. in Schlecht. Linnæa, **26**: 383. 1854.—A rather slender, glabrous perennial 6–7.5 dm. (2°–2½°) high, with very sharp-pointed, usually erect leaves and 4 to 8 approximate, usually somewhat curved racemes 2–3 cm. (1′–1¼′) long. Sheaths compressed; leaf-blades smooth, 1.5–2.5 dm. (6′–10′) long, about 3 mm. (1⅓″) wide. Spikelets (*b*, *c*) crowded in two or three rows (*a*) obovate, subacute, 2–3 mm. (1″–1⅓″) long; empty glumes 3-nerved the first, shown at (*b*) very minutely pubescent, the second smooth. The dorsal view of the flowering glume is shown by *d* and the anterior view of the palea by *e*.—Low grounds, Texas.

Plant often geniculate, more or less creeping at the base.

FIG. 331. **PASPALUM SCROBICULATUM** Linn. Mant. 1: 29. 1767. DITCH MILLET.—A densely cæspitose perennial 2–6 dm. ($\frac{2}{3}$°–2°) high, with rather soft culms, often geniculate at the lower joints, narrow, flat leaves, and 2 to 5 racemes 2–4 cm. ($\frac{3}{4}$′–1$\frac{1}{2}$′) long, approximate near the summit of the culm or its branches. Spikelets (*b*, *c*) rounded, obtuse, 2–3 mm. (1″–1$\frac{1}{3}$″) long. A portion of the axis of a raceme with 2 spikelets is shown at *a*; dorsal view of flowering glume, *d*; anterior view of palea, *e*.—Wet places, Florida (No. 5760, Curtiss, 1896). (Tropical countries of both hemispheres.) August, September.

Cultivated throughout the plains region of northern India as a "rainy-season crop." The grain is eaten by the lower classes and the straw is used for fodder.

FIG. 332. **PASPALUM BLODGETTII** Chapm. Fl. So. U. S. 571. 1860.—A slender, densely cæspitose, erect perennial 4–9 dm. ($1\frac{1}{3}$°–3°) high, with flat, glabrous, thin leaves and about 4 slender racemes 2–4 cm. ($\frac{3}{4}$′–$1\frac{1}{2}$′) long. Sheaths exceeding the internodes, smooth or bearded at the apex; leaf-blades 1–2.5 dm. (4′–10′) long, about 5 mm. ($2\frac{1}{4}$″) wide. Spikelets (*b*, *c*) elliptical-oblong, obtuse, about 1.5 mm. ($\frac{3}{4}$″) long, with the 3-nerved outer glumes thinly and minutely pubescent. A portion of the axis of a raceme is shown at *a*, the dorsal view of the flowering glume, *d*, and anterior view of the palea, *e*.—Southern Florida.

Very variable as to the length of the leaves.

FIG. 333. **PASPALUM GIGANTEUM** Baldw. in Vasey, Bul. Torr. Bot. Club, **13**: 166. 1886. GIANT WATER-GRASS.—A stout, erect, coarse perennial 8–18 dm. ($2\frac{2}{3}$°–6°) high, with broad, flat leaves and 2 to 5 racemes 15–25 cm. (6′–10′) long. Sheaths loose, striate, exceeding the internodes, the lower ones pilose; leaf-blades 30–60 cm. (12′–24′) long, 2–3 cm. ($\frac{3}{4}$′–$1\frac{1}{4}$′) wide, smooth or sparsely pubescent. Spikelets (*b*, *c*) about 3 mm. ($\frac{1}{8}$″) long, crowded, obtuse, arranged in pairs in two rows as shown by the portion of the axis and pedicels at *a*; empty glumes smooth, 3-nerved. The flowering glume is shown by *d*, and the palea by *e*.—Moist ground and ditches, Florida. June to August.

FIG. 334. **PASPALUM BIFIDUM** (A. Bertol.) Nash. Bul. Torr. Bot. Club, **24**: 192. 1897. (*Panicum bifidum* A. Bertol. Mem. Acad. Sci. Bolog. **2**: 598, *pl. 41, f. 2, e–h.* 1850; *Paspalum racemulosum* Nutt. in Chapm. Fl. So. U. S. 571. 1860.) LOOSELY-FLOWERED PASPALUM.—A slender, erect perennial 6–12 dm. (2°–4°) high, from stout, scaly rootstocks, with long, flat leaves, villous sheaths, at least the lower ones, and slender, rather remotely flowered racemes 5–12 cm. (2′–5′) long; spikes 2 to 4, slender, erect, 8–10 cm. (3′–4′) long. Spikelets (*a*, *b*) on comparatively long pedicels, obovate, obtuse, about 3 mm. (1⅛″) long; flowering glume (*c*) glabrous. The anterior view of the palea, with the plumose stigmas, a portion of the grain, and the lodicules, are shown in *d*.—Dry, sandy soil, pine barrens of Alabama and Florida westward to Louisiana and **Texas. August to October.**

FIG. 335. **PASPALUM MONOSTACHYUM** Vasey, in Chapm. Suppl. Fl. So. U. S. 665. 1884.—A rigid, erect perennial 6–10 dm. (2°–3⅓°) high, from a creeping rootstock, with very long, narrow, involute leaves, the lower ones often 3–6 dm. (1°–2°) long, and 1 (rarely 2) terminal raceme 15–20 cm. (6′–8′) long. Spikelets (*c*, *d*) crowded, in two rows along one side of the filiform rachis (*a*, *b*), oblong, obtuse, 3 mm. (1⅛″) long; first glume 3-nerved, somewhat shorter than the spikelet; second glume equaling the flowering glume. The palea is shown by *e*.—Low grounds, Florida to Texas.

FIG. 336. **ANTHÆNANTIA RUFA** (Ell.) Schultes, Mant. **2**: 258. 1824. (*Aulaxanthus rufus* Ell. Sk. Bot. S. C. and Ga. **1**: 103. 1817; *Panicum rufum* Kunth.) RED-HAIRED ANTHÆNANTIA.—A slender, erect, glabrous, and rather rigid perennial 3–8 dm. (1°–3°) high, from creeping rootstocks, with narrow, green, or often rufous, rather loosely-flowered panicles 8–15 cm. (3′–6′) long. Sheaths crowded at the base; leaf-blades 2–4 dm. (8′–16′) long, 3–5 mm. (1½″–2½″) wide, obtuse, rigid, erect or ascending, glabrous. Spikelets (*a*) 3 mm. (1½″) long, villous with spreading hairs on the outer glumes; sterile flower neutral, anthers and stigmas purple. The flowering glume, dorsal view, is shown by *b*.—Moist, sandy soil, pine barrens North Carolina to Florida and westward to Texas. August to October.

FIG. 337. **ANTHÆNANTIA VILLOSA** (Michx.) Beauv. Agrost. 48, *t. 10, f.* 7. 1812. (*Phalaris villosa* Michx. Fl. Bor. Am. 1: 43. 1803; *Panicum ignoratum* Kunth.)—An erect, somewhat wiry perennial, 6–12 dm. (2°–4°) high, from strong, creeping rootstocks, with flat, rather short leaves and loosely flowered panicles 10–20 cm. (4′–8′) long. Sheaths loose, crowded at the base; leaf-blades spreading, 1–2.5 dm. (4′–10′) long, 5–8 mm. (2½″–4″) wide. Spikelets (*a*) about 3 mm. (1⅓″) long, outer glumes villous with spreading hairs. Sterile flower with 3 stamens; anthers and stigmas yellow.—Dry, sandy soil, in open pine barrens, etc., South Carolina to Florida and westward to Louisiana and Texas. July to October.

FIG. 338. **ERIOCHLOA SERICEA** Munro in Vasey, U. S. Dept. Agr. Div. Bot. Bul. **121**: 1, *pl. 1.* 1890. SILKY EVERLASTING-GRASS.—A slender, erect, tufted perennial 3–10 dm. (1°–3½°) high, with numerous basal leaves and slender, simple, racemose panicles 15–20 cm. (6′–8′) long, consisting of 6 to 10 alternate, appressed branches, the lower ones about 2 cm. (1′) in length. Sheaths mostly shorter than the internodes; leaf-blades narrow, 10–25 cm. (4′–10′) long, softly pubescent. Spikelets (*b*, *c*) elliptical-oblong, acute, 3–4 mm. (1⅓″–2″) long, imbricate in two rows along one side of the flat rachis (*a*); outer glumes silky-villous; flowering glume of the second flower is shown by *d* and the palea by *e*. Pedicels (shown in *a*) bearing hairs as long as the spikelets.—Dry soils, Texas to Arizona. September.

FIG. 339. **PANICUM SANGUINALE** Linn. Sp. Pl. 57. 1753. (*Digitaria sanguinalis* Scop.; *Syntherisma præcox* Walt.; *S. sanguinalis* Dulac.) CRAB-GRASS.—A much-branched, leafy annual, more or less decumbent and rooting at the lower nodes. Stems 3–12 dm. (1°–4°) long; nodes and sheaths usually hairy; ligule 2 mm. (1″) long; leaf-blades flaccid, 5–12 cm. (2′–5′) long, 4–8 mm. (2″–4″) wide, scabrous, sometimes pilose, and usually purple tinged. Spikelets (*a*, *b*) 2.5–3 mm. (1¼″–1⅓″) long, lanceolate, acute, in digitate or subfasciculate racemes, which are 5–18 cm. (2′–7′) long; first glume very minute; second about one-half as long as the spikelet, usually ciliate and 3-nerved; flowering glume (*c*) smooth.—Throughout the United States. (Warmer temperate regions of both hemispheres.) June to September.

Crab-grass, although a weed in the Northern States, is of great value as a forage plant in the South, the volunteer growth furnishing excellent pasturage and a good quality of hay. In Bohemia, Europe, the grain is used for food. Often a troublesome weed in lawns.

FIG. 340. **PANICUM PLATYPHYLLUM** Munro in Vasey, Contr. U. S. Nat. Herb. **3**: 27. 1892. FLAT-LEAFED PANIC-GRASS.—A much-branched, ascending, leafy perennial, often rooting at the lower joints, with flowering stems 3–5 dm. (12′–20′) high, smooth sheaths, and lanceolate leaf-blades 8–10 cm. (3′–4′) long. Panicle consisting of 3 to 5 simple, alternate, spreading branches 4–8 cm. (1¼′–3′) long. Spikelets (*a*, *b*, *c*) broadly ovate, oblong, obtuse, about 4 mm. (2″) long, alternate on the flattened rachis; first glume obtuse, one-third as long as the 5-nerved, smooth second one; third glume subtending an oblong palea. The flowering glume is shown by *e*, and the palea by *f*.—Low grounds, Texas. (Cuba.) June, July.

FIG. 341. **PANICUM PROSTRATUM** Lam. Tabl. Encycl. 1: 171. 1791. LOW PANIC-GRASS.—A slender, creeping, and much-branched perennial, with short, ciliate leaves and terminal panicles, composed of 5 to 10 simple racemes. Culms ascending, rooting below, 3–6 dm. (1°–2°) long. Sheaths shorter than the internodes; leaf-blades 4–5 cm. (1½′–2′) long, acute, clasping at the base; rachis frequently with stiff hairs. Spikelets (*a*, *b*, *c*) ovate, oblong, glabrous, about 2 mm. (1″) long. First glume one-fourth as long as the second and third; flowering glume (*e*) striate-punctate, mucronate-pointed. The palea is shown in *f*.—Moist, wet grounds, New Jersey (ballast), Alabama to Florida, and westward to Louisiana and eastern Texas. (Tropical countries of both hemispheres.) September.

FIG. 342. **PANICUM SACCHARATUM** Buckl. Prel. Rept. Geol. and Agrl. Surv. Tex. 2. 1866. (*P. lachnanthum* Torr. 1857. Not Hochst. 1855.) COTTON-GRASS.—A leafy, erect perennial 3–9 dm. (1°–3°) high, usually much-branched below; culms terminated by narrow panicles 10–20 cm. (4′–8′) long. Sheaths mostly exceeding the internodes, smooth or more or less pubescent; leaf-blades 5–15 cm. (2′–6′) long, plane, generally more or less pubescent. Spikelets (*a*, *b*) about 3 mm. (1¼″) long, densely silky-villous, the spreading hairs 3–4 mm. (1½″–2″) long. The second and third glumes are shown by *c*, *d*, the flowering glume by *e*, and the fertile palea by *f*.—Dry hillsides, canyons, etc., southern Colorado, Texas, New Mexico, and Arizona. A grass which is apparently of much economic value in the semiarid regions of the Southwest.

FIG. 343. **PANICUM TENERRIMUM** Kunth, Rev. Gram. 1: 39. 1829. (*Trichachne tenuis* Nees. Agrost. Bras. 89. 1829.) SLENDER WOOLLY GRASS.—**A slender, erect, branching, and leafy perennial** (?) 2–5 dm. (8′–20′) high, with short and rather rigid, flat leaves, and simple panicles about 10 cm. (4′) long. Leaf-blades flat, 5 cm. (2′) long or less, rather rigid; lower sheaths often pubescent. Spikelets (*a*, *b*, *c*) 2 mm. (1″) long; the first glume glabrous; the second and third glumes densely clothed with short, **silky hairs; flowering** glume (*e*) smooth. The anterior view of the flowering glume enveloping the palea is shown at *f*.—Low grounds, Pecos County, Texas: rare. (South America.) **September, October.**

FIG. 344. **PANICUM CILIATISSIMUM** Buckl. Prel. Rept. Geol. and Agrl. Surv. Tex. 4. 1866. INDIAN WHEAT. CARPET GRASS.—A creeping, much-branched, leafy perennial, with upright flowering stems 1–3 dm. (4′–12′) high, and narrow, few-flowered panicles 2–4 cm. (1′–1¾′) long. Nodes bearded, leaves of the flowering branches 5–10 cm. (2′–4′) long, ciliate below. Sheaths somewhat ciliate. Spikelets (*a*, *b*) 3.5–4 mm. (1¾″–2″) long. First glume lanceolate, 3-nerved, smooth except at the base, two-thirds as long as the spikelet; second glume densely ciliate-hairy near the margin; third glume (*c*) somewhat shorter than the second, ciliate on the margins, its palea equaling it in length; flowering glume (*d*) obtuse, minutely roughened. The fertile palea is shown by *e*.—Low grounds, southern Texas. May.

This species is locally known as carpet grass. The extensively creeping, short-jointed, and leafy stems of this plant present a close resemblance to Bermuda grass.

FIG. 345. **PANICUM URVILLEANUM** Kunth, Rev. Gram. 1: 35 et 2: 403, *t. 115.* 1835. WOOLLY-FLOWERED PANIC.—A stout, erect perennial 3–6 dm. (1°–2°) high, with long, flat leaves and open panicles 15–25 cm. (6′–10′) long. Leaf-blades rigid, 3–4.5 dm. (12′–18′) long and 6 mm. (3″) wide at the base, becoming involute and ending in long, setaceous points, the upper ones exceeding the panicle. Spikelets (*a*, *b*, *c*) 4–6 mm. (2″–3″) long, ovate: empty glumes silky-villous; first glume 7-nerved, two-thirds as long as the 15-nerved second one: third glume (*d*) slightly shorter; flowering glume (*f*) long-ciliate on the margins, otherwise smooth. Whole plant more or less hairy.—Sandy soil, southern California and Arizona. (South America.) March to June.

Var. LONGIGLUMIS Scribn. var. nov. has the spikelets 8 mm. (4″) long with the first glume nearly as long as the second, and both long-acuminate pointed. San Jacinto, Southern Calif. No. 887 S. B. & W. F. Parish, June, 1882.

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FIG. 346. **PANICUM PHILADELPHICUM** Bernh. in Trin. Gram. Pan. 216. 1826, as synonym; Nees. Agrost. Bras. 198. 1829. (*Panicum diffusum* Pursh, Fl. Am. Sept. **1**: 68. 1814. Not Swartz. 1788; *P. capillare minus* Muhl. Descr. 124. 1817. Not *P. pubescens minor* Poir. in Lam. Encycl. **4**: 272. 1816; nor *P. minus* Nash. Bul. Torr. Bot. Club, **22**: 421. 1895; *P. capillare flexile* Gatt. Tenn. Fl. 94. 1887; *P. flexile* Scribn. Bul. Torr. Bot. Club. **20**: 416. 1893.) WIRY PANIC-GRASS.—A rather slender, erect annual 3–6 dm. (1°–2°) high, branching at the base, with flat leaves, capillary panicles, and rather distant spikelets. Culms **pilose or bearded at the nodes**; sheaths more or less pilose or hirsute; ligule very short, ciliate-fringed; leaf-blades 8–25 cm. (3′–10′) long, 3–8 mm. (1½″–4″) wide, sparsely hairy or nearly smooth. **Spikelets** (*a*, *b*, *c*) 3 mm. (1½″) long, acute, or acuminate; flowering glume (*d*) narrowly oblong, obtuse.—In both moist and dry sandy soils, Pennsylvania and Michigan southward to Floridaa and Mississippi. July to October.

FIG. 347. **PANICUM COGNATUM** Schultes, Mant. **2**: 235. 1824. (*P. divergens* Muhl. 1817. Not H. B. K. 1815; *P. autumnale* Bosc. 1825.) FALL WITCH-GRASS.—A slender, erect, or ascending perennial, usually much-branched at the base, 3–6 dm. (1°–2°) high, with rather short, narrow leaves and diffusely branching panicles one-third the length of the culm or more. Sheaths smooth, or the lower ones sparsely hairy; ligule obtuse, conspicuous; leaf-blades 5–7 cm. (2′–3′) long, 4–6 mm. (2″–3″) wide, scabrous on the margins. Spikelets (*a*, *b*, *c*) solitary on the ends of the branches, spindle-shaped or obovate, 2–3 mm. (1″–1¼″) long, the first glume very minute; second and third glumes ciliate at the apex, exceeding the flowering glume (*d*).—Dry soil, South Carolina and Florida to Illinois, Minnesota, Kansas, and Arizona. June to October.

Fig. 348. **PANICUM CAPILLARIOIDES** Vasey, Contr. U. S. Nat. Herb. 1: 54. 1890. TEXAS WITCH-GRASS.—An erect, more or less branching perennial 2.5–5 dm. (10′–18′) high, with narrow and more or less elongated flat leaves and diffuse panicles 15 cm. (6′) long. Spikelets (*a*, *b*) narrowly lanceolate, acute, 5–6 mm. (2½″–3″) long; first glume one-third as long as the second, 3- to 5-nerved; second and third glumes subequal, smooth, about 15-nerved. Palea of the sterile flower (*c*) small, 1–1.5 mm. (½″–¾″) long; flowering glume (*d*) less than 2 mm. (1″) long, smooth and shining.—Southern California, and Texas. May.

In habit and appearance much like *P. capillare*, but less hirsute, with smaller, more rigid panicles and much larger, clustered spikelets.

FIG. 349. **PANICUM MINIMUM** (Engel.) Scribn. & Merrill, U. S. Dept. Agr. Div. Agros. Cir. **27**: 4. 1900. (*Panicum capillare minimum* Engel. in Scribn. Tenn. Agr. Exp. Sta. Bul. **7**: 44, *fig. 40.* 1894; *P. minus* Nash, Bul. Torr. Bot. Club, **22**: 421. 1895. Not *P. capillare minor* Muhl. Descr. 124. 1817.) SMALL WITCH-GRASS.—A slender annual, rarely more than 3 dm. (1°) high, with long-pilose sheaths, narrow, flat leaves, and oval or pyramidal, few-flowered panicles 8–16 cm. (3′–6′) long. Leaf-blades 5–10 cm. (2′–4′) long, 2–6 mm. (1″–3″) wide, erect, more or less pilose or pubescent. Spikelets (*a*, *b*, *c*) about 1.5 mm. ($\frac{1}{16}$″) long, elliptical, acute, smooth, borne singly or in pairs at the ends of the ultimate branches; first glume about one-third as long as the equal, acute, second and third ones. The flowering glume and palea are shown by *d* and *e*.—Dry woods and thickets, New Brunswick to Michigan and Missouri, south to Georgia. August, September.

FIG. 350. **PANICUM CAPILLARE** Linn. Sp. Pl. 58. 1753. OLD WITCH-GRASS or FOOL HAY.—An annual, with usually coarse, branching stems 3–9 dm. (1°–3°) high, hairy or hirsute sheaths, and widely spreading capillary panicles 6–24 cm. (2′–10′) long. Sheaths pilose to densely hirsute; ligule very short, ciliate; leaf-blades flat, lanceolate or linear, acute, usually thinly hairy on both sides. Spikelets (*a*, *b*, *c*) acute, smooth, about 2 mm. (1″) long, ovate, acute or acuminate, smooth. The flowering glume is shown by *d* and the palea by *e*.—A weed in cultivated fields, especially in sandy soils, Maine and Nova Scotia to British Columbia, southward to Florida and Texas. (Europe.) July to October.

Var. GATTINGERI Nash. Brit. and Br. Illus. Fl. 1: 123. 1896. Has more slender culms, numerous lateral panicles, the terminal one rarely exceeding 15 cm. (6′) in length.

Fig. 351. **PANICUM HIRTICAULUM** Presl, Rel. Haenk. 1: 308. 1830. ROUGH PANIC-GRASS.—A slender or occasionally rather stout, erect perennial (?) 1.5–7.5 dm. (½°–2½°) high, often geniculate at the lower nodes, with papillate-pilose sheaths, flat and usually glabrous leaves, and terminal, more or less spreading, many-flowered panicles. Sheaths usually shorter than the internodes; leaf-blades 5–20 cm. (2′–8′) long, 4–10 mm. (2″–5″) wide, acute, sometimes ciliate on the margins and pilose with scattered hairs above. Spikelets (*a*, *b*, *c*) lanceolate, acute, about 3 mm. (1⅛″) long, glabrous. First glume acuminate, two-thirds as long as the spikelet; second and third glumes lanceolate-acuminate, 5- to 7-nerved. The third glume and sterile palea is shown by *d*, the flowering glume by *e*, and the fertile palea by *f*.—Texas, New Mexico, and Arizona to Washington. (Mexico, Galapagos Islands.) August, September.

Distinguished from *P. capillare* L. by its stiffer and more strongly tuberculate hairs and longer first glume which is ½ to ⅔ the length of the spikelet.

FIG. 352. **PANICUM STIPITATUM** Nash, in Britt. Manuel, 83. 1901. (*Panicum elongatum* Pursh, Fl. Am. Sept. 1: 69. 1814. Not Salisb. Prodr. 18. 1796.) MUNRO-GRASS.—A stout, erect, glabrous, and branching perennial 10–15 dm. (3°–5°) high, with long, flat leaves, and pyramidal panicles terminating the culm and its branches. Sheaths usually exceeding the internodes, compressed, glabrous; ligule very short; leaf-blades 25–45 cm. (10′–18′) long, 6–12 mm. (3″–6″) wide, scabrous. Spikelets (*a, b, c*) very acute, about 2.5 mm. (1¼″) long, crowded. The third glume and palea are shown by *d*, the dorsal view of the flowering glume by *e*, and anterior view of same showing palea by *f*.—Wet meadows and along the banks of streams, New Jersey to North Carolina and **Kentucky**. August, September.

This species is closely related to *Panicum agrostoides* Spreng., but is distinguished by its longer and more acute spikelets and usually spreading secondary panicles. Apparently included in *P. agrostoides* by Muhlenberg.

FIG. 353. **PANICUM DIVARICATUM** Linn. Amœn. Acad. **5**: 302. 1759. (*P. latifolium* Linn. Sp. Pl. in part, reference to Solane's figure only.) SMALL CANE.—A coarse, woody, bamboo-like perennial 18–24 dm. (6°–8°) high, reclining or climbing over bushes, with usually numerous short and spreading flower-bearing branches at the nodes. Leaves lanceolate-acute, 5–10 cm. (2′–4′) long, 4–12 mm. (2″–6″) wide, deciduous from the persistent sheaths. Panicles simple, few-flowered. Spikelets (*a*, *b*) swollen, about 4 mm. (2″) long; lower glume triangular-ovate, one-third as long as the spikelet; second and third glumes 9- to 11- nerved; apex of the flowering glume (*d*) pubescent. Anterior view of the third glume and its palea is shown by *c*.—Dry woods and thickets, southern Florida. (West Indies, Mexico, and tropical America.) March to September.

FIG. 354. **PANICUM GYMNOCARPON** Ell. Sk. Bot. S. C. and Ga. 1: 117. 1817. MARSH PANIC-GRASS.—A fibrous-rooted, smooth perennial, with geniculate, ascending stems 6–12 dm. (2°–4°) high, with long and rather broad, flat leaves and simple, terminal panicles about 30 cm. (12′) long. Sheaths shorter than the internodes, striate; leaf-blades 3 dm. (1°) long or more, 2 cm. (1′) wide, cordate at the base. Spikelets (*a, b, c*) lanceolate-acute, about 6 mm. (3″) long, arranged along one side of the panicle branches; empty glumes lanceolate, scabrous on the keel, two to three times as long as the flowering glume (*e*); third glume (*d*) about 5-nerved, inclosing a palea one-half as long as itself The fertile palea is shown by *f*.—**Low grounds, Georgia and Florida, westward** to Louisiana and Texas. July to September.

Of no recognized agricultural value.

FIG. 355. **PANICUM RAMISETUM** Scribn. U. S. Dept. Agr. Div. Agros. Cir. **27**: 9. 1900. (*P. subspicatum* Vasey, U. S. Dept. Agr. Div. Bot. Bul. **8**: 25. 1889. Not Desv. Opuscules 84. 1831.) NARROW TOPPED PANIC.—A slender, erect, more or less branching, leafy perennial 2–4 dm. (8′–16′) high, with flat, more or less spreading leaves, and narrow, nearly simple, terminal panicles, the ultimate branches terminating in a short bristle. Leaf-blades 2–12 cm. (1′–5′) long, 2–6 mm. (1″–3″) wide, rather rigid, light green, acute, the upper longer than the lower ones. Spikelets (*a*, *b*, *c*) about 2.2 mm. (1″) long, the first glume one-half as long as the spikelet; second glume 7-nerved; third glume 5-nerved; rachis with a short bristle at the apex and sometimes a bristle below the spikelets. The flowering glume is shown by *d* and the palea by *e*.—Dry, sandy plains, southern Texas. August.

FIG. 356. **PANICUM REVERCHONI** Vasey, U. S. Dept. Agr. Div. Bot. Bul. 8: 25. 1889. REVERCHON'S PANIC.—A slender, erect, and rather densely cæspitose perennial 25–45 cm. (10′–18′) high, with very narrow, erect leaves and terminal, simple panicles, the appressed branches terminating in short bristles; leaf-blades mostly basal, plane, or involute, 5–20 cm. (2′–8′) long, 1–3 mm. (½″–1½″) wide. Spikelets (*a*, *b*) 3–4 mm. (1½″–2″) long; first glume one-half as long as the spikelet, 3- to 5- nerved, obtuse; flowering glume (*c*, *d*) finely pitted or striate.—Sandy plains, Texas. June to September.

FIG. 357. **PANICUM WRIGHTIANUM** Scribn. U. S. Dept. Agr. Div. Agros. Bul. **11**: 44, *fig. 4.* 1898.—A slender, much-branched, leafy perennial, with smooth, delicate panicles 2–3 cm. ($\frac{3}{4}'$–$1\frac{1}{4}'$) long, and minute spikelets (*a, b, c*) 0.8 mm. ($\frac{3}{8}''$) long, the second and third glumes of which are minutely and densely pubescent. Leaves 1–3 cm. ($\frac{1}{3}'$–$1\frac{1}{4}'$) long, 2–3 mm. ($1''$–$1\frac{1}{3}''$) wide, minutely pubescent on the under side, sparingly pilose above. First glume about one-third as long as the spikelet or shorter: third glume (*d*) with a small palea; flowering glume (*e*) smooth and shining, obtuse. Closely related to *P. baldwinii* Nutt., but readily separated from that species by its pubescent culms and leaves and smaller, pubescent spikelets.—Moist, sandy soil in open pine woodlands, Mississippi and Florida. (Cuba.) May to October.

FIG. 358. **PANICUM BALDWINII** Nutt. in Chapm. Fl. So. U. S. ed. 3: 587. 1897. Scribn. U. S. Dept. Agr. Div. Agros. Bul. 11: 41, *fig.* 8. 1898. (*Panicum nitidum* var. *minor* Vasey; *P. dichotomum* var. *nitidum* Chapm.)—A densely caespitose, slender, glabrous perennial 1-3 dm. (4'-12') high, with short, narrow, and more or less spreading leaves, ovoid or pyramidal panicles 3-5 cm. (1'-2') long, and glabrous ovoid or pear-shaped spikelets (*a, b, c*) about 1 mm. (1/24') long. Sheaths much shorter than the internodes, excepting the lower basal ones, margins ciliate; ligule a short, dense fringe of hairs; leaf-blades 2-5 cm. (1'-2') long, 1-4 mm. (1/24'-1/6') wide, acute, glabrous or with a few marginal hairs near the base. First glume obtuse, about one-fourth as long as the spikelet; third glume with a palea; flowering glume (*d*) obtuse.—Rather dry, sandy soil in open woodlands, Georgia and Florida to Mississippi. April to September.

Fig. 359. **PANICUM ALBOMARGINATUM** Nash. Bul. Torr. Bot. Club, **24:** 40. 1897.—A slender, erect, glabrous, caespitose perennial 1.5–4.5 dm. (6′–18′) high, with short sheaths and comparatively firm, erect leaves 1.5–4.5 cm. (⅝′–1¾′) long, bordered with a conspicuous, serrulate, white margin. Panicles ovate, 2.5–4 cm. (1′–2′) long, with many obovate, obtuse, minutely pubescent spikelets (*a*, *b*) 1.5 mm. (1/16″) long, first glume one-fourth to one-third as long as the spikelet, second and third glumes 7-nerved, the latter (*c*) with a short palea; fourth or flowering glume (*d*) obtuse, inclosing a palea (as shown at *e*) of equal length.—Low pine woodlands and swamps, Florida. April to October.

Illustration drawn from the type specimen

FIG. 360. **PANICUM LEUCOTHRIX** Nash, Bul. Torr. Bot. Club, **24**: 41. 1897.—A slender, erect or ascending, sparingly branched perennial 1–4.5 dm. (4′–18′) high, with short, erect leaves 2–6 cm. (¾′–2½′) long, and ovate or oval, rather densely flowered panicles 2.5–6 cm. (1′–2½′) long. Sheaths pubescent with ascending or closely appressed, long, white hairs; ligule a ring of long, white, erect hairs; leaf-blades 3–7 mm. (1⅓″–3⅓″) wide, glabrous above, pubescent beneath with short, appressed hairs. Spikelets (*a*, *b*, *c*) obovate, about 1 mm. (½″) long, the 7-nerved second and third glumes pubescent, the third (*d*) with a short palea; flowering glume (*e*) elliptical-oblong, obtuse.—Sandy soil in low pine barrens and cypress swamps, Florida. (West Indies.) June to October.

Illustration drawn from the type specimen, which was collected in low pine land at **Eustis, Lake County**, Florida.

FIG. 361. **PANICUM ERECTIFOLIUM** Nash. Bul. Torr. Bot. Club, **23**: 148. 1896. (*P. sphærocarpon floridanum* Vasey. U. S. Dept. Agr. Div. Bot. Bul. **8**: 33. 1889. Not *P. floridanum* Trin. 1834.)—A rather stout, glabrous perennial 4–6 dm. (16′–24′) high, with erect and rather rigid leaves and terminal at length exserted, many-flowered, ovate or oblong panicles 7–12 cm. (3′–5′) long. Ligule a ring of short hairs; leaves ciliate toward the base, the lower 7–14 cm. (3′–6′) long. Spikelets (*a*, *b*, *c*) about 1.5 mm. ($\frac{1}{16}$″) long, the second and third glumes minutely pubescent, fourth glume (*d*) broadly oval, obtuse.—Swamps, Florida and Mississippi. March to July.

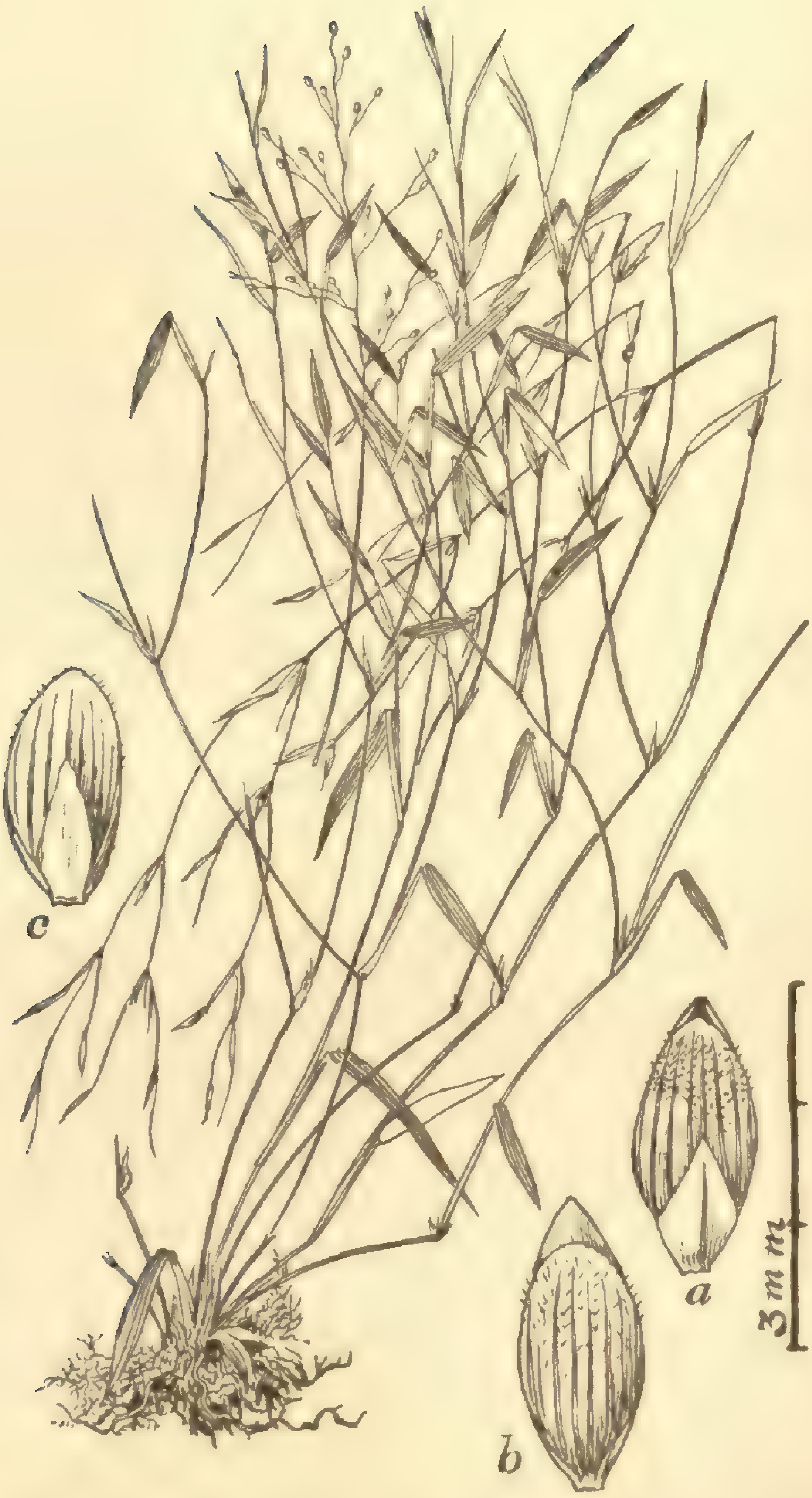

FIG. 362. **PANICUM SPHAGNICOLUM** Nash, Bul. Torr. Bot. Club, **22**: 422. 1895.—A slender, ascending or reclining perennial 4–10 dm. ($1\frac{1}{3}$°–3°) high, at first simple, finally much branched, with spreading, smooth leaves 4–8 cm. ($1\frac{1}{2}$′–3′) long, and small, spreading panicles 4–5 cm. ($1\frac{1}{2}$′–2′) long. Sheaths of the primary culm hirsute, those of the branches glabrous; ligule a ring of short hairs. Spikelets (*a*, *b*) 2.5–3 mm. ($1\frac{1}{4}$″–$1\frac{1}{3}$″) long, with the second and third glumes minutely pubescent, at least near the apex; first glume ovate, acute, nearly one-half the length of the spikelet; third glume (*c*) 7–9-nerved, with a delicate palea.—**Low, boggy places, chiefly in thickets and low swamps. Florida. June to October.**

FIG. 363. **PANICUM LUCIDUM** Ashe, Journ. E. Mitch. Sci. Soc. **15**: 47. 1898. (*P. ramulosum* Michx.?)—A very slender, erect or reclining, glabrous perennial 3–10 dm. (1°–3°) high, with short, flat, acute leaves 1–3 cm. ($\frac{1}{2}'$–$1\frac{1}{4}'$) long, and small, spreading panicles 2–6 cm. ($\frac{3}{4}'$–$2\frac{1}{4}'$) long. Sheaths short, glabrous, ciliate on the overlapping margins; ligule none. Spikelets (*a*, *b*, *c*) elliptical-ovate, obtuse, 1.8 mm. (nearly 1″) long, with the second and third glumes entirely glabrous; first glume very small; the third (*d*) with a short, delicate palea.—Low woods, New Jersey, southward and westward to Texas; common.

Distinguished from *P. sphagnicolum* Nash by its smaller and glabrous spikelets and smooth sheaths.

FIG. 364. **PANICUM WERNERI** Scribn. in Britt. and Br. Illus. Fl. **3**: 501. 1898.—A slender, erect, glabrous perennial 2.5–4.5 dm. (10′–18′) high with erect, nearly linear, very acute leaves 5–8 cm. (2′–3′) long, and open, ovoid or pyramidal panicles 5–8 cm. (2′–3′) long. Lower nodes sparingly bearded; sheaths glabrous or pubescent at the apex; ligule short, ciliate; leaf-blades glabrous, 3–5 mm. (1⅓″–2⅓″) wide. Branches of the panicle flexuous. Spikelets (*a*, *b*) obovate or oblong, obtuse, about 2.2 mm. (a little over 1″) long, the obtuse second and third glumes glabrous or sparsely and minutely pubescent; flowering glume (*c*) obtuse, smooth, and shining.—Dry, gravelly soils, Ohio and New York. This species is very closely related to *P. linearifolium*.

Fig. 365. **PANICUM POLYANTHES** Schultes, Mant. **2**: 257. 1824. (*P. multiflorum* Ell. 1817. Not Poir. 1816 *P. microcarpon* Muhl. June, 1817. Not ex Ell. Jan. 1817.)—A rather stout, erect, and finally sparingly branched, glabrous perennial 3–8 dm. (1°–2½°) high, with broad, spreading leaves, many-flowered panicles, 7–18 cm. (3′–7′) long, and minutely pubescent, nearly spherical spikelets (*a*, *b*, *c*) about 1.5 mm. (1/16″) long. Sheaths striate; ligule none; upper leaves longer than the lower ones 12–25 cm. (5′–10′) long, lanceolate from a cordate-clasping ciliate base. First glume minute, the second and third 7-nerved; the third with a small hyaline palea; flowering glume (*d*) shining, round-ovoid, obtuse.—Dry, open woodlands and occasionally in open grounds, New York southward to Florida and westward to Michigan, Nebraska, and Texas. June to October.

Panicum microcarpon Ell. is *P. barbulatum* Michx. as now understood.

FIG. 366. **PANICUM DICHOTOMUM** Linn. Sp. Pl. 58. 1753. (?) (*Panicum dichotomum viride* Vasey, U. S. Dept. Agr. Div. Agros. Bul. 8: 30. 1889.)—A slender, glabrous, and finally much-branched above, somewhat wiry perennial 2–6 dm. ($\frac{2}{3}$°–2°) high, with pale-green, spreading leaves 4–8 cm. ($1\frac{1}{4}$′–3′) long, and open panicles. Lateral panicles small and few-flowered. Spikelets (*a*, *b*, *c*) oblong-elliptical, nearly 2 mm. (1″) long, glabrous. The later growth of this species has the aspect of a little tree.—Dry thickets and open woodlands, New England to Illinois and southward to the Gulf of Mexico. May to October.

It is not known exactly what *Panicum dichotomum* Linn. is. The form above is considered as representing that species, as it more nearly fulfills the original description than any other.

FIG. 367. **PANICUM VILLOSISSIMUM** Nash, Bul. Torr. Bot. Club, **23**: 149. 1896. (*Panicum pubescens* of Scribn. Bul. Tenn. Agr. Exp. Sta. 7^2: 52. 1894. Not Lam.)—A slender, erect or assurgent, and finally much-branched perennial 1.5–5 dm. (6′–20′) high, with flat, ascending and rather firm, narrowly-lanceolate, pubescent leaves 5–10 cm. (2′–4′) long, and diffuse, ovate or pyramidal panicles bearing obovate spikelets (*a*, *b*, *c*), which are 2 mm. (1″) in length. Culms villous; nodes pubescent; sheaths densely villous, shorter than the internodes; ligule a dense fringe of short hairs; leaf-blades papillate-pilose with long white hairs. Panicles about 7 cm. (3′) long; axis pilose; the second and third glumes pilose, the latter (*d*) with a small palea; flowering glume (*e*) obtuse.—Dry soil, usually in open woodlands, from New Jersey to South Dakota and southward to the Gulf. May to September.

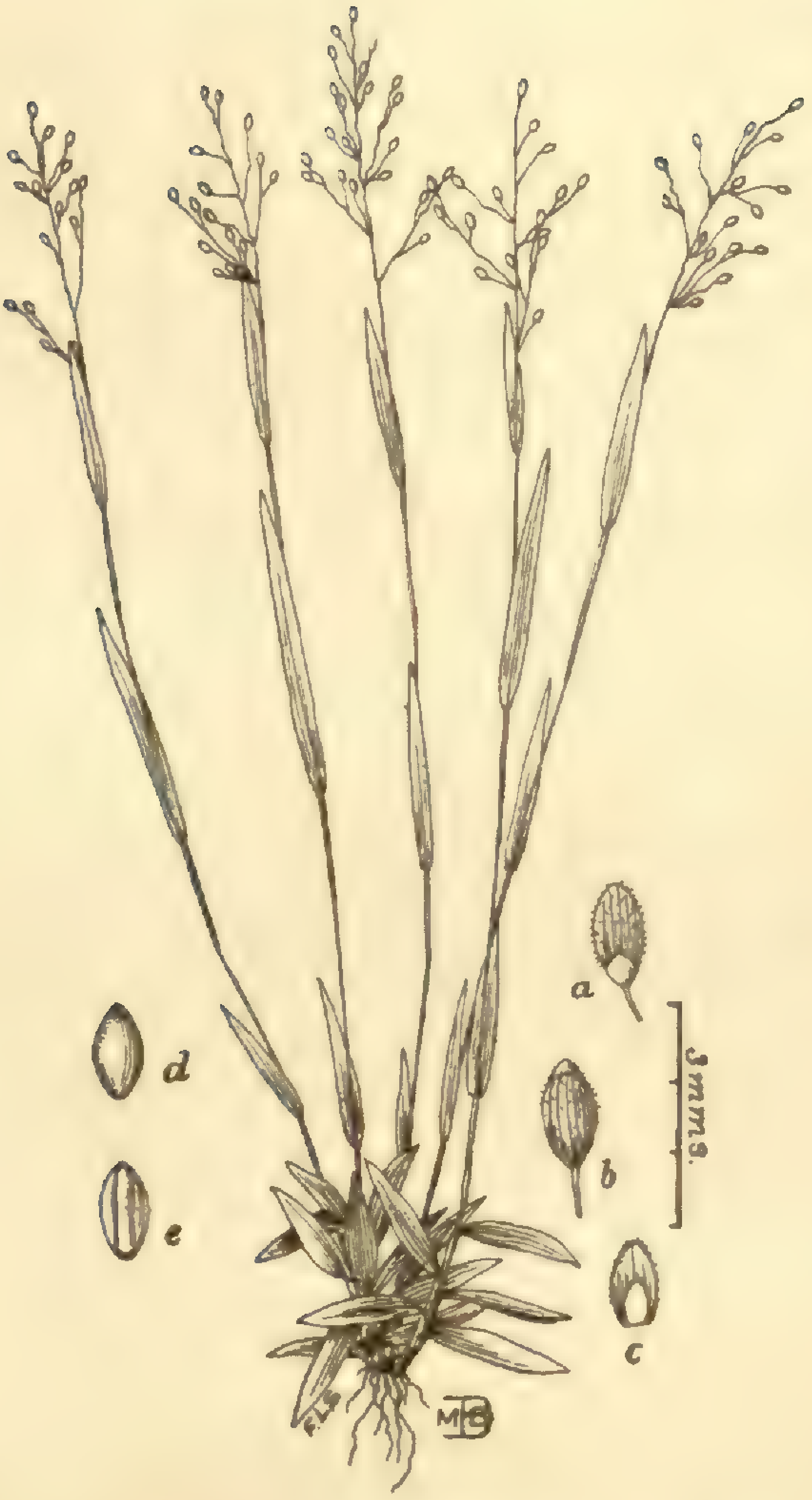

FIG. 368. **PANICUM BRITTONI** Nash, Bul. Torr. Bot. Club, **24**: 194. 1897. BRITTON'S PANIC-GRASS.—A slender, erect, cæspitose perennial, with rigid culms 1–2 dm. (4′–8′) high, erect leaves, and ovate panicles 2–3 cm. (¾′–1¼′) long. Ligule a ring of short hairs, culm leaves 1–3 cm. (½′–1¼′) long. Spikelets (*a*, *b*) ovate or obovoid, obtuse, 1.4 mm. (1/18″) long, with the second and third glumes densely pubescent; first glume about one-third as long as the spikelets, acutish; the second and third glumes 7-nerved, the third (*c*) with a palea about one-half its length; fourth glume (*d*) obtusely apiculate.—Pine barrens, New Jersey. May to July.

FIG. 369. **PANICUM NITIDUM OCTONODUM** (Smith) Scribn. & Merrill. U. S. Dept. Agr. Div. Agros. Bul. **24**: 34. 1901. (*Panicum octonodum* J. G. Smith, U. S. Dept. Agr. Div. Agros. Bul. **17**: 73. June 30, 1899.)—A slender, erect, unbranched, glabrous perennial 4–6 dm. (16′–24′) high, with linear, rigid, erect or ascending, smooth leaves, and narrowly pyramidal, rather densely flowered panicles 5–10 cm. (2′–4′) long. Ligule a rather dense fringe of hairs. Spikelets (*a*, *b*) elliptical-ovate, obtuse, 1.5 mm. (about $\frac{1}{16}$″) long; second and third glumes faintly 7-nerved and glabrous. In swamps, Delaware and Texas. July to September.

Distinguished from the species (fig. 371) by its glabrous spikelets.

FIG. 370. **PANICUM TSUGETORUM** Nash, Bul. Torr. Bot. Club, **25**: 86. 1898.—A slender, tufted, and at length much-branched perennial 2–4.5 dm. (8′–18′) high, with the culm, sheaths, and lower surface of the leaves appressed-pubescent, and broadly ovate panicles 4–6.5 cm. (1½′–2½′) long. Ligule a ring of hairs about 1 mm. (½″) long; leaf-blades glabrous above, 4–8 cm. (1¾′–3¼′) long, 5–8 mm. (2½″–4″) wide. Spikelets (*a*, *b*) about 1.8 mm. (nearly 2″) long, broadly obovate, the outer glumes pubescent with short, spreading hairs, third glume (*c*) with a short palea.—Open woods, under evergreens, New York. June to August.

FIG. 371. **PANICUM NITIDUM** Lam. Tabl. Encycl. **1**: 172. 1791. (*Panicum spretum* Schultes, Mant. **2**: 248. 1824: *P. eatoni* Nash, Bul. Torr. Bot. Club, **25**: 84. 1898: *P. paucipilum* Nash, ibid. **26**: 573. 1899.)—A smooth, erect, caespitose, finally much-branched perennial 4–10 dm. (16′–40′) high, with erect, lanceolate leaves and rather narrow and densely flowered panicles 7–13 cm. (3′–5′) long. Ligule a ring of long hairs: leaf-blades 4–10 cm. (1½′–4′) long, 3–10 mm. (1¼″–5″) wide. Spikelets ovate-oblong, about 1.6 mm. (¾″) long. The second and third glumes densely pubescent with spreading hairs: first glume very short, 1-nerved, glabrous: the second and third 7-nerved, the latter (*d*) with a small palea: flowering glume (*e*) oblong, obtuse.—Low, wet grounds, Maine to Indiana, Mississippi and Texas, mostly near the coast.

See Scribn. & Merrill, U. S. Dept. Agr. Div. Agros. Bul. **24**: 32. Notes on *Panicum nitidum* Lam. etc. 1901.

FIG. 372. **PANICUM ATLANTICUM** Nash, Bul. Torr. Bot. Club, **24**: 346. 1897.—A slender, erect, much-branched perennial 3–5 dm. (12′–20′) high, with the culm, sheaths, and erect, linear-lanceolate leaves papillate-pilose with long, white, spreading hairs. Nodes bearded, with a glabrous ring immediately below; ligule a ring of hairs 2–5 mm. (1″–2½″) long; leaf-blades 3–10 cm. (1¼′–4′) long, with scabrous margins. Panicle 4–6.5 cm. (1½′–2½′) long, its axis pilose at the base, hispidulous above, as are the branches and pedicels. Spikelets (*a, b, c*) obovate, obtuse, about 2 mm. (1″) long, the 9-nerved second and third glumes densely pubescent with short, spreading hairs; third glume (*d*) with a small palea; flowering glume (*e*) broadly oval to orbicular.—In open woods, Massachusetts to Virginia. June to August.

FIG. 373. **PANICUM IMPLICATUM** Scribn. U. S. Dept. Agr. Div. Agros. Bul. 11: 43. July 20, 1898.—A weak, slender, hairy perennial 3–5 dm. (12′–20′) high, with rather short, mostly erect leaves and diffusely branching, pyramidal panicles 3–5 cm. (1′–2′) long. Culms pilose with soft spreading hairs; nodes bearded, with a glabrous ring immediately below. Leaf-blades pilose on both sides. Axis of the panicle and its flexuous branches pilose. Spikelets (*a*, *b*, *c*) 1.5 mm. ($\frac{1}{16}$″) long, obovate, obtuse, minutely pubescent; first glume minute; the third (*d*) with a small palea; fourth glume (*e*) ovate, obtuse.—Low grounds near the coast, from Maine to Delaware. June to August.

Spikelets smaller and panicle branches more flexuose than in *P. atlanticum* Nash. Very closely related to *Panicum unciphyllum* Trin. (*P. pubescens* of authors, not Lam.) and perhaps only a variety of that species, distinguished by its more slender culms and smaller panicles and leaves.

FIG. 374. **PANICUM ADDISONII** Nash, Bul. Torr. Bot. Club, **25**: 83. 1898.—A rather slender, erect or decumbent, and finally much-branched, stiff perennial 2.5–4 dm. (10′–16′) high, with more or less pubescent sheaths, lanceolate, rigid, nearly glabrous leaves, and ovate or oblong panicles 2–6 cm. (1′–2½′) long. Culms pubescent below, with long appressed hairs; nodes sparsely hairy. Sheaths sparingly appressed-pubescent, at least the lower ones; leaf-blades 2–6 cm. (1′–2½′) long, 3–6 mm. (1½″–3″) wide. Spikelets (*a*, *b*) broadly obovate, 2 mm. (1″) long, with the 9–11-nerved second and third glumes densely pubescent, with long, spreading hairs; first glume nearly one-half as long as the third (*c*), which has a thin palea; flowering glume (*d*) oblong, obtuse.—Sandy soil, New Jersey. May, June.

Spikelets smaller and plants less pubescent than in *P. consanguineum* Kunth.

FIG. 375. **PANICUM PEDICELLATUM** Vasey. U. S. Dept. Agr. Div. Bot. Bul. 8: 28. 1889.—A slender, erect or ascending, and finally much-branched, glabrous perennial 3–6 dm. (1°-2°) high, with ascending, acute leaves 5–8 cm. (2′-3¼′) long, open, few-flowered panicles, and oblong, minutely pubescent spikelets (*a*, *b*, *c*) about 3 mm. (1½″) in length. First glume rather remote, about one-half as long as the spikelet; second and third glumes oblong, obtuse, 7-nerved. The third glume (*d*) had a small palea.—In open rocky woodlands, Texas. May, June.

Allied to *P. angustifolium* Ell.

Fig. [illegible]. **PANICUM NUDICAULE** Vasey, U. S. Dept. Agr. Div. Bot. Bul. 8: 31. 1889.—A slender, erect, smooth perennial [illegible] dm. ([illegible]) high, with narrow-lanceolate, glabrous leaves [illegible] cm. ([illegible]) long, much-exserted few-flowered panicles [illegible] cm. ([illegible]) long and elliptical, oblong, glabrous spikelets (a, b) [illegible] mm. ([illegible]) long. Culm leaves remote. First glume minute, the third with a thin palea and nearly one-fourth longer than the fourth or flowering glume (d).—Swamps, Santa Rosa County, Florida. April to May.

FIG. 377. **PANICUM WEBBERIANUM** Nash, Bul. Torr. Bot. Club, **23**: 149. 1896. WEBBER'S PANIC-GRASS. A rather rigid, erect or ascending, and more or less branched perennial 2 4 dm. (8′–16′) high, with lanceolate, spreading leaves, and ovate, spreading panicles 6 9 cm. (2½′–3½′) long. Sheaths (excepting the lowermost) and leaves glabrous; ligule very short and minutely ciliate; **leaf-blades 5–10 cm. (2′–4′) long. Spikelets** (*a*, *b*, *c*) elliptic or obovate, 2.5 mm. (1¼″) long, with the second and third glumes minutely pubescent, as is the fourth or flowering glume (*e*) near its obtuse **apex; third glume** (*d*) **with a** small palea.—Low pine lands, Florida. May to August.

FIG. 378. **PANICUM LAXIFLORUM** Lam. Encycl. **4**: 748. 1797.—A slender, densely tufted perennial about 3 dm. (1°) high, with rather long, pale-green, soft leaves and loosely few-flowered, pilose panicles 4–6 cm. (1½′–2½′) long. Sheaths papillate-pilose with spreading or deflexed hairs. Spikelets (*a*, *b*, *c*) ovate-elliptical, obtuse, about 2 mm. (1″) long; first glume very small, the second and third glumes pubescent, the latter with a small palea.—Dry or moist, open woodlands, Virginia to Florida and westward to Tennessee and Louisiana. March to October.

Lamarck describes *P. laxiflorum* as having both sides of the leaves glabrous. There is doubt about the identification of Lamarck's species which can only be settled by an examination of his type in the Paris Museum.

FIG. 379. **PANICUM CILIATUM** Ell. Sk. Bot. S. C. and Ga. **1**: 126. 1817. (*Panicum ciliatifolium* Kunth, Rev. Gram. **1**: 36. 1829: *P. leucoblepharis* Trin. Clav. Agrost. Antiq. 234. 1822.)—A slender, densely tufted perennial 1–3 dm. (4′–12′) high, with rather short, finely ciliate sheaths and leaves and diffuse, few-flowered panicles. Leaves glabrous, 2–6 cm. (¾′–2½′) long, 4–12 mm. (2″–6″) wide. Panicles ovate-pyramidal, 2–3 cm. (¾′–1¼′) long. **Spikelets** (*a*, *b*, *c*) about 2 mm. (1″) long, first glume about one-half the length of the spikelet, glabrous, second and third glumes minutely pubescent, **the latter** (*d*) **with a small** palea in its axil: flowering glume (*e*) minutely apiculate.—Moist, open woodlands in sandy soil, North Carolina to Florida and westward to Mississippi. March to October.

FIG. 380. **PANICUM POLYCAULON** Nash, Bul. Torr. Bot. Club, **24**: 200. 1897.—A low, pale-green, densely cæspitose perennial 1–2 dm. (4′–8′) high, with erect or ascending, oblong-lanceolate leaves 2–7 cm. (¾′–2¾′) long, ciliate on the margins, and ovate panicles 2–3 cm. (¾′–1¼′) long. Ligule a ring of very short hairs. Spikelets (*a*, *b*) about 1.5 mm. (⅔″) long, obovate, obtuse, the 7-nerved second and third glumes glabrous, the latter with a small palea.—Damp, open grounds and margins of lakes, Virginia to Florida and Mississippi. (West Indies.)

This species is separated from the closely allied *P. ciliatum* Ell. by its narrower leaves, more slender culms, and smaller, glabrous spikelets.

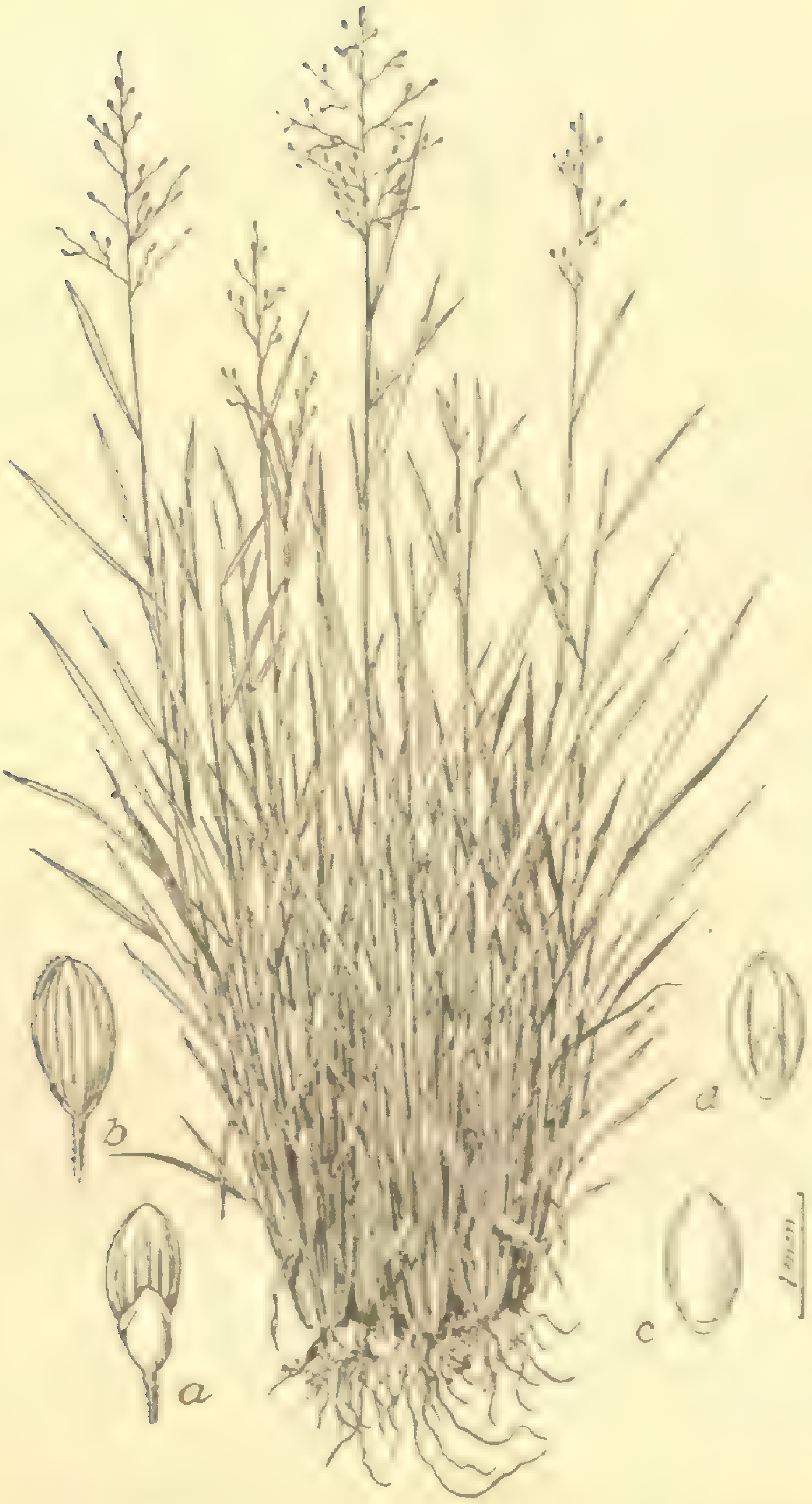

FIG. 381. **PANICUM GLABRIFOLIUM** Nash, **Bul. Torr. Bot. Club, 24: 196. 1897.**—A slender, densely caespitose, and rigidly erect, wiry perennial 1.5–4 dm. (6′–16′) high, with narrow, linear, erect, and rather rigid leaves and ovate panicles 4–6 cm. ($1\frac{1}{2}$′–$2\frac{1}{4}$′) long. Culms leafy to the top, the lower nodes bearded lowermost sheaths pubescent; ligule a fringe of short hairs; leaf-blades 3–9 cm. ($1\frac{1}{4}$′–$3\frac{1}{2}$′) long, 1–3 mm. ($\frac{1}{2}$″–$1\frac{1}{2}$″) wide. Spikelets (*a*, *b*) 1–1.2 mm. (about 1″) long, obovate; the 5–7-nerved second and third glumes glabrous, the latter with a small palea.—Rich, damp soil, Florida. July to October.

Spikelets a little larger and leaves more elongated than in *P. baldwinii*, with which *P. glabrifolium* is closely related.

FIG. 382. **PANICUM CILIIFERUM** Nash, Bul. Torr. Bot. Club, **24**: 195. 1897.—A densely cæspitose, erect, or finally much-branched pubescent perennial 2–8 dm. (8′–30′) high, with broadly ovate, few-flowered panicles 7–9 cm. (3′–4′) long. Nodes bearded, with a glabrous ring immediately below: sheaths papillate-hirsute; ligule a dense ring of hairs; leaf-blades glabrous above, rough and pubescent beneath, the margins ciliate. Spikelets (*a*, *b*) obovate, 2.5 mm. (1¼″) long, the 9-nerved second and third glumes strongly pubescent, the third with a palea.—High pine lands, Florida. March to August.

Closely related to *P. malacon* Nash, distinguished by its broader and shorter leaves, more open panicles, and differently shaped spikelets. The illustration is drawn from the type collected by Geo. V. Nash in Florida.

FIG. 383. **PANICUM MANATENSE** Nash. Bul. Torr. Bot. Club, **24**: 42. 1897.—A glabrous, much-branched perennial with diffusely spreading glabrous culms 2–4 dm. (8′–16′) long, nearly erect leaves 3.5–9 cm. ($1\frac{1}{4}$′–$3\frac{3}{4}$′) long, and ovate, rather few-flowered panicles 4–6 cm. ($1\frac{1}{2}$′–$2\frac{1}{4}$′) long. Ligule truncate, very short; leaf-blades rounded and sparsely ciliate at the base. Spikelets (*a*, *b*, *c*) elliptical-oblong, pubescent, about 3.5 mm. ($1\frac{3}{8}$″) long, with distinct papillæ between the nerves of the second and third glumes, the latter (*d*) with a small palea; fourth glume (*e*) strongly apiculate.—Florida and (?) Georgia to Louisiana.

Distinguished from *P. commutatum* by its larger and more acute spikelets. Closely allied to *P. joorii* Vasey, but readily separated from that species by its larger spikelets.

FIG. 384. **PANICUM LINEARIFOLIUM** Scribn. U. S. Dept. Agr. Div. Agros. Bul. **11**: 42. *pl. 1.* 1898.—A slender, erect, densely caespitose perennial 2–4 dm. (8′–16′) high, with long, linear-lanceolate, erect leaves and simple, open panicles 5–8 cm. (2′–3½′) long. Culms simple or branching near the base, glabrous; sheaths glabrous or pilose with rather long spreading hairs; ligule a dense fringe of hairs; leaf-blades scabrous or sparingly pilose. Spikelets (*a, b*) 2–2.5 mm. (1″–1¼″) long, obovate, obtuse, with the 7-nerved second and third glumes glabrous or sparingly pilose, third glume (*c*) with a small palea; fourth glume (*d*) nearly as long as the third.—Sandy soil in woodlands, sparingly in open grounds, New England southward to Virginia and westward to Texas. June to August.

Distinguished from *P. depauperatum* by its smaller and more obtuse spikelets.

FIG. 385. **PANICUM DEPAUPERATUM** Muhl. Gram. 112. 1817.—A slender erect, or ascending perennial, usually much branched near the base, 1.5–4 dm. (6′–16′) high, with very narrow, erect leaves 8–20 cm. (3′–8′) long, few-flowered narrow panicles 4–10 cm. (1½′–4′) long, and rather glabrous spikelets (*a, b, c*) 3–4 mm. (1½″–2″) long; second and third glumes acuminate-pointed, conspicuously longer than the fourth (*e*); the third glume (*d*) has a small palea. Sheaths pilose in the type.—Open woodlands and gravelly fields from Nova Scotia and Manitoba southward to Florida and Texas. May to August.

FIG. 386. **PANICUM SCOPARIUM** Lam. Encycl. **4**: 744. 1797. Michx. Fl. Bor. Am. **1**: 49. 1803. Not of other authors. (*Panicum pubescens* Lam. l. c. 748. Michx. l. c. Not of other authors; *Panicum viscidum* Ell. Sk. Bot. S. C. and Ga. **1**: 123. 1817.)—A rather stout, erect or ascending, finally much-branched perennial 6–12 dm. (2°–4°) high. Leaves rather broad, very acute, those on the primary stem 12–25 cm. (5′–10′) long. Panicle 10–15 cm. (4′–6′) long, ovate or subpyramidal, many-flowered. Spikelets (*a, b, c*) 2 mm. (1‴) long, rounded-obovate; first glume very small, the second and third glumes nearly equal, densely pubescent; the third (*d*) with a small palea; fourth glume (*e*) broadly oval, obtuse. Whole plant or at least the culm and sheaths densely pubescent with soft, spreading hairs, and all parts somewhat viscid when fresh.—Low ground, borders of thickets, etc., from New Jersey and Delaware southwest to Florida and westward to Indiana and Texas. June to October.

See Scribner & Merrill, U. S. Dept. Agr. Div. Agros. Bul. **24**: 34. 1900. Notes on *Panicum scoparium* Lam., and *Panicum pubescens* Lam.

FIG. 387. **PANICUM SCABRIUSCULUM** Ell. Sk. Bot. S. C. and Ga. 1: 121. 1817.—A rather stout, erect, and finally sparingly branched perennial 9–15 dm. (3°–5°) high, with narrowly lanceolate leaves 8–16 mm. (4‴–8‴) wide, and 7–20 cm. (2¾′–8′) long. Panicle spreading 12–20 cm. (5′–8′) long. Spikelets (a, b, c) 2 mm. (1‴) long, glabrous. First glume very short, the third (*d*) with a thin palea; **fourth or flowering glume (*e*) shorter than** the third.—Low grounds, North Carolina to Florida and westward to Texas. May to August.

This species is closely allied to *Panicum scoparium* Lam. (*P. viscidum* Ell.), but is distinguished from that species by its glabrous sheaths, **leaves, and** spikelets.

FIG. 388. **PANICUM CLANDESTINUM** Linn. Sp. Pl. 58. 1753.—A stout, erect, or ascending perennial, finally branching above, 6–12 dm. (2°–4°) high, with broad leaves and terminal diffuse panicles 8–13 cm. (3′–5′) long. Culms glabrous or papillate-pilose above; sheaths usually very rough tuberculate-hispid; ligule very short. On the branches the shorter leaves are more rigid and crowded. Spikelets (*a*, *b*, *c*) oblong, smooth or finely pilose, 3 mm. (1/8″) long. The panicles on the branches are for the most part included within the uppermost sheaths.—Low thickets, Quebec to Michigan and southward to Georgia and Texas. May to September.

FIG. 389. **PANICUM MALACON** Nash. Bul. Torr. Bot. Club. **24**: 197. 1897 — A rather rigid, erect, and finally much-branched perennial 4–6 dm. (16′–24′) high, with bearded nodes, hairy sheaths and stems, firm, erect leaves 3–10 cm. (1′–4′) long, and open few-flowered ¦panicles 7–10 cm. (3′–4′) long. Ligule a fringe of short hairs. Spikelets (*a*, *b*) obovate, obtuse, pubescent, 3–3.5 mm. (1¼″–1⅓″) long. The first glume 3- to 5- nerved about one-half as long as the spikelet; second and third glumes 9-nerved, densely pubescent; the third (*c*) with a thin palea. Whole plant pubescent, with white, ascending hairs.—High pine lands of southern Florida. May.

FIG. 390. **PANICUM ANGUSTIFOLIUM** Ell. Sk. Bot. S. C. and Ga. 1: 129. 1817.—A rather slender but rigid, erect, more or less pubescent perennial. 3–6 dm. (1°–2°) high, at first simple, finally much branched throughout. Leaves of the primary stems erect, 8–15 cm. (3′–6′) long, and 4–6 mm. (2″–3″) wide, those of the wiry branches shorter and much narrower. Panicles 7–10 cm. (3′–4′) long, spreading, and rather loosely flowered. Spikelets (*a, b, c*) 3 mm. (1½″) long, oblong, obtuse; outer glumes finely pubescent, the flowering glume (*d*) with a few short hairs at the apex.—Dry soil, Delaware to Florida and westward to Missouri and Texas. March to October.

FIG. 391. **PANICUM WILCOXIANUM** Vasey, U. S. Dept. Agr. Div. Bot. Bul. **8** : 32. 1889.—A rather slender, very hairy, and finally much-branched perennial 2-2.5 dm. (8′-10′) high, with erect acute leaves, and small, spreading panicles 2-3 cm. (¾′-1¼′) long. Spikelets (*a, b, c*) oblong, obtuse, 3 mm. (1¼″) long, with pubescent outer glumes; the third glume with a small hyaline palea; fourth glume (*e*) about as long as the third.—**Dry prairies**, Kansas northward through Nebraska and South Dakota to Manitoba. June to August.

Allied to *P. scribnerianum* Nash, but more hairy throughout, with narrower and more erect leaves and branching of the panicle quite different.

FIG. 392. **PANICUM MALACOPHYLLUM** Nash, Bul. Torr. Bot. Club, **24**: 198. 1897.—A hairy, erect, or ascending perennial 2–4 dm. (8′–16′) high, at length much branched above, with narrow, softly pubescent leaves and open panicles 3–5 cm. (1′–2′) long, the flexuous branches bearing obovate spikelets (*a, b, c*) 3–3.5 mm. (1½″–1¾″) long. Outer glumes densely pubescent, with rather long, spreading hairs. The third glume (*d*) with a small hyaline palea; the fourth glume (*e*) round-ovate, obtuse.—Cedar barrens, etc., Tennessee to Arkansas and Indian Territory. **May to July.**

This species is allied to *P. scribnerianum* Nash, but differs in its longer and softer pubescence, more flexuous panicle branches, smaller and somewhat more acute spikelets. Its range is much more limited.

FIG. 393. **PANICUM SCRIBNERIANUM** Nash, Bul. Torr. Bot. Club, **22** : 421. 1895. (*P. scoparium* A. Gray in part. Not Lam. *P. scoparium minor* Scribn. Bul. Tenn. Agr. Experiment Station 7^2: 48. 1894.)—An erect and finially branching perennial 1.5–6 dm. (6'–24') high, with usually papillate-pilose sheaths, more or less spreading, flat leaves, which are smooth and scabrous beneath, and small, ovoid panicles 2–4 cm. (¾'–1¼') long. Spikelets (*a, b, c*) obovoid, 3 mm. (⅛") long, nearly glabrous. In dry or moist soils from Maine and Ontario westward to Washington, and southward to Tennessee, Texas, and Arizona. May to September.

This grass is distinct from *Panicum ravenelii* Scribn. & Merrill (*P. coparium* Ell.) and very unlike *P. scoparium* Lam., which is the same as *P. viscidum* of Elliott.

FIG. 394. **PANICUM PAUCIFLORUM** Ell. Sk. Bot. S. C. and Ga. 1: 12? 1817.—A comparatively stout, usually erect, and finally branching perennial 3–5 dm. (12′–20′) high, with hairy sheaths, narrow leaves and small, few-flowered panicles. Leaves 7-10 cm. (3′–4′) long, 6–8 mm. (3″–4″) wide, glabrous on the upper surface, roughened and pubescent beneath, the margins fringed with long hairs particularly near the base. Sheaths pubescent, bearded at the throat. Spikelets (*a*, *b*, *c*) oval or oblong, 4 mm. (2″) long, the second and third glumes pubescent, the latter with a thin hyaline palea.—Loose or more or less sandy and usually damp soils, Georgia and South Carolina. May to October.

Fig. 395. **PANICUM EQUILATERALE** Scribn. U. S. Dept. Agr. Div. Agros. Bul. 11: 42, *pl.* 2. 1898.—A rather stout, erect, and densely caespitose, glabrous perennial **3–6 dm. (1°–2°) high, with long,** lanceolate leaves and open panicles 7–10 cm. (3′–4′) long. Ligule very short, almost obsolete; leaf-blades 5–17 cm. (2′–7′) long, minutely scabrous above, and usually with a few long hairs on the margin near the base. Spikelets (a, b, c) elliptical or obovate, obtuse, 3–3.5 mm. (1⅛″–1⅜″) long, with the first glume 3-nerved, the second and third nearly equal, 7- to 10-nerved, slightly pubescent; the third with a thin hyaline palea; the fourth glume (e) about the length of the third.—Pine and "hummock" lands, **Florida. June to August.**

FIG. 396. **PANICUM LATIFOLIUM** Linn. Sp. Pl. 58. 1753. Excluding reference to Sloane. (*P. walteri* Poir; *P. porterianum* Nash.)—A rather slender branching perennial 3–6 dm. (1°–2°) high, with broad ovate-lanceolate leaves and few-flowered, nearly simple panicles. Nodes glabrous or bearded with soft, spreading or reflexed hairs; leaf-blades 5–13 cm. (2′–5′) long, 8–32 mm. (4″–16″) wide, glabrous or thinly pubescent. Spikelets (*a*, *b*, *c*) ovate-elliptical or pear-shaped, obtuse, about 4 mm. (2″) long, outer glumes more or less pubescent, the first glume one-fourth to one-third as long as the others, 3-nerved; second and third glumes obtuse 9- to 11- nerved, the third (*d*) with a palea nearly as long as itself and sometimes a staminate flower; apex of the fourth glume (*e*) pubescent.—Common in open woodlands and thickets, Massachusetts and Ontario to Minnesota, and southward to Florida and Texas. May to October.

The form with pubescent sheaths and leaves is the variety *molle* Vasey. (*P. pubifolium* Nash, Bul. Torr. Bot. Club, **26**: 577. 1899.)

FIG. 397. **PANICUM LEIBERGII** Scribn. U. S. Dept. Agr. Div. Bot. Bul. 8: 32. 1889. As synonym (*P. scoparium leibergii* Vasey, l. c.)—A slender, erect or ascending perennial 3–6 dm. (1°–2°) high, with rather broad, flat leaves and few-flowered panicles of comparatively large, obtuse **spikelets** (*a, b, c*) **3–4 mm.** (1⅓''–2'') long, the outer glumes papillate-pilose with stiff, spreading hairs. Culms strongly scabrous, finally much branched: sheaths papillate-pilose to hirsute; ligule a very narrow and minutely ciliate ring, leaf-blades rough-pilose on the lower surface, sparingly pilose above. Third glume (*d*) with a thin palea; fourth glume (*e*) oblong, obtuse. The palea is shown by *f*.—In dry or moist soil, open woodlands, etc. Iowa, Minnesota, the Dakotas, and Missouri. May to July.

FIG. 398. **PANICUM OVALE** Ell. Sk. Bot. S. C. and Ga. **1**: 123. 1817. (*Panicum erythrocarpon* Ashe, Journ. E. Mitch. Sci. Soc. **16**: 90. 1900.)—A rather stout, erect, and finally much-branched perennial 3–5 dm. (12′–20′) high, with villous culms and sheaths and ovate panicles 5–8 cm. (2′–3⅓′) long. Nodes densely bearded with soft hairs, a glabrous ring immediately below the nodes; ligule a ring of short hairs; leaf-blades erect or ascending 4–10 cm. (1⅗′–4′) long, 5–10 mm. (2⅓″–5″) wide, lanceolate, acute, pubescent beneath, glabrous or nearly so above, serrulate-scabrous on the margins. Spikelets (*a*, *b*, *c*) obovate or oval 2.5–3 mm. (1¼″–1⅓″) long. The second and third glumes pubescent, the latter with a small hyaline palea.—In dry soil, South Carolina to Florida. May to July.

FIG. 399. **PANICUM XANTHOPHYSUM** A. Gray, Ann. Lyc. N. Y. 3 : 233. 1835. (*Panicum calliphyllum* Ashe. Journ. E. Mitch. Sci. Soc. 15 : 31. 1898.)—A slender or occasionally rather stout, erect perennial 3–6 dm. (1°–2°) high, sparingly **branching** near the base, with broadly lanceolate leaves 6–15 cm. (2½′–6′) **long, and simple** few-flowered, racemose **panicles 3–10 cm. (1′–4′) long.** Nodes **usually bearded**: sheaths glabrous or pilose, often pubescent at the apex; leaf-blades **with 7 to 11** prominent nerves glabrous or ciliate near the base. Spikelets (*a, b, c*) obovate, obtuse, about 3 mm. (1⅛″) long, the strongly nerved second and third glumes pubescent, the latter (*d*) with a thin hyaline palea. The flowering glume is shown by *e* and the palea by *f*.—Dry, sandy soil, Maine to New Jersey and westward to Minnesota and Manitoba. June to September.

FIG. 400. **OPLISMENUS HIRTELLUS** (Linn.) R. & S. Syst. **2**: 481. 1817. (*Panicum hirtellum* Linn. Syst. Nat. ed. 10, 870. 1759.) CREEPING BEARD-GRASS.—**A weak, decumbent, and more or less extensively creeping perennial 3–6 dm. (1°–2°) long, with broad, flat leaves and simple, racemose panicles 6–8 cm. (2½′–3½′) long.** Sheaths rather loose, usually shorter than the internodes; leaf-blades 1.5–6 cm. (¾′–2½′) long, 5–12 mm. (2½″–6″) wide, acute or acuminate, somewhat scabrous. Spikelets (*a*) about 3 mm. (1½″) long; empty glumes about equal, the first bearing an awn about 6 mm. (3″) long, the awn of the second glume much shorter; third glume exceeding the empty glumes, 7-nerved, somewhat pilose, short-awned.—Moist woodlands and swamps, Georgia and Florida, westward to Louisiana and Texas. (Mexico and South America.) June to October.

FIG. 401. **CHÆTOCHLOA GLAUCA** (Linn.) Scribn. U. S. Dept. Agr. Div. Agros. Bul. **4**: 39. 1897. (*Panicum glaucum* Linn. Sp. Pl. 56. 1753: *Setaria glauca* Beauv. Agrost. 51. 1812.) YELLOW FOXTAIL.—An erect, leafy annual 3–9 dm. (1°–3°) high, usually much branched near the base, with flat leaves and bristly, spike-like panicles 2–8 cm. (1′–3′) long. Sheaths loose, glabrous; leaf-blades 5–15 cm. (2′–6′) long, 4–8 mm. (2″–4″) wide, long-acuminate, smooth or scabrous. Bristles 5 to 10 to each spikelet, 3–8 mm. (1½″–4″) long, usually yellow. Spikelets (*a*, *b*) about 3 mm. (1½″) long, with the second glume about one-half the length of the transversely rugose flowering glume, as shown in *a*.—Fields and waste places about dwellings, etc. Widely distributed in North America. Naturalized from Europe. June to September.

A common weed in cultivated grounds.

FIG. 402. **CHÆTOCHLOA MAGNA** (Griseb.) Scribn. U. S. Dept. Agr. Div. Agros. Bul. **4**: 39. 1897. (*Setaria magna* Griseb. Fl. Brit. W. Ind. 554. 1864.)

GIANT MILLET.—A stout, erect, leafy annual 10–36 dm. (3°–12°) high, much branched below, with broad, flat leaves and bristly, densely flowered panicles 15–35 cm. (6′–14′) long. Sheaths loose, glabrous; leaf-blades 3–6 dm. (1°–2°) long, 1–3 cm. ($\frac{1}{2}$′–1$\frac{1}{4}$′) wide, scabrous, attenuate. Rachis of the panicle densely pilose. Spikelets (*a*, *b*) about 2 mm. (1″) long; second and third glumes equaling the shortly apiculate flowering glume (*c*, *d*) which is very smooth (not striate nor rugose) and glossy.—Low grounds along the coast from Delaware and Virginia southward to Florida and westward to Texas. (West Indies, Bermudas, and Central America.) July to October.

FIG. 403. **CHÆTOCHLOA VERTICILLATA** (Linn.) Scribn. U. S. Dept. Agr. Div. Agros. Bul. **4**: 39. 1897. (*Panicum verticillatum* Linn. Sp. Pl. ed. 2. 82. 1762; *Setaria verticillata* Beauv. Agrost. 51. 1812.) BRISTLY FOX-TAIL.—A leafy, upright annual 3–6 dm. (1°-2°) high, much branched near the base, with rather slender, spike-like panicles 5–10 cm. (2′-4′) long. Sheaths loose, glabrous, shorter than the internodes; leaf-blades 7–18 cm. (3′-7′) long, 6-12 mm. (3″-6″) wide, scabrous, acuminate. Bristles as long as or a little exceeding the spikelets, downwardly barbed. Spikelets (*a*, *b*) nearly sessile, 2-2.5 mm. (1″-1¼″) long, the first glume one-third as long as the spikelet; second and third glumes 5- to 7- nerved, equaling the flowering glume; flowering glume narrowly elliptical, rounded at the apex, smooth or nearly so.—Fields and waste places, New England to Virginia and Kentucky, westward to South Dakota and Nebraska. Naturalized from Europe. June to September.

FIG. 404. **CENCHRUS GRACILLIMUS** Nash, Bul. Torr. Bot. Club, **22**: 300. 1895. SLENDER SAND-BUR.—An ascending, sparingly branched, slender leafy annual 3–6 dm. (1°–2°) high, with loosely flowered, slender spikes 3–5 cm. (1′–2′) long. Sheaths smooth, the lower ones exceeding the upper ones, shorter than the internodes; leaf-blades complanate, 5–8 cm. (2′–3′) long, about 2 mm. (1″) wide, scabrous on the midvein and margins. Involucres (*b*) ovate, smooth with numerous long, slender, usually purplish spines. Spikelets (*c*) about 8 mm. (4″) long, exserted beyond the involucre for about one-half their length.—High pine lands, Florida. April to September.

This species is readily distinguished from *C. echinatus* and *C. tribuloides* by its long, slender, usually purple spines, smooth involucres, and closely complanate leaves.

FIG. 405. **CENCHRUS INCERTUS** M. A. Curtis, Bost. Journ. Nat. Hist. **1**: 135. 1837. (*C. strictus* Chapm. Bot. Gaz. **3**: 20. 1878.) SOUTHERN SAND-BUR.—A smooth, ascending, and more or less branched perennial (*f*) 4.5–9 dm. (1½°–3°) high, with flat leaves and slender spikes 5–8 cm. (2′–3′) long; sheaths smooth, inflated; leaf-blades 4–15 cm. (2′–6′) long, 3–5 mm. (1¼″–2¼″) wide, plane, smooth. Spikelets inclosed in a bur-like involucre (*a*) which is naked (free from spines) below, with 6 to 12 stout spines above.—Sandy soil along the coast, Georgia to Florida and westward to Texas. June to October.

The smaller involucres, naked at the base, with fewer and shorter spines distinguish this plant from *Cenchrus tribuloides*, which it somewhat resembles. From *C. gracillimus* it is distinguished by its pubescent involucres, which are spiny to the base.

FIG. 406. **CENCHRUS MACROCEPHALUS** (Doell) Scribn. U. S. Dept. Agr. Div. Agros. Bul. **17**: 110, *f. 406*. 1899. (*C. tribuloides macrocephalus* Doell, F. Bras. **2**[2]. 312. 1877, ex char.) LARGE SAND-BUR.—A coarse, much-branched and leafy annual, with prostrate or ascending culms 3–6 dm. (1°–2°) long, and dense spikes 2–8 cm. (1′–3′) long. Sheaths very loose, glabrous, rarely pubescent, generally ciliate on the margins above, often exceeding the internodes, the upper one generally somewhat inclosing the panicle; ligule densely ciliate-fringed; leaf-blades rigid, involute, 3–10 cm. (1½′–4′) long, glabrous. Involucres or "burs" (*a*) pubescent, about 8 mm. (4″) long and 6 mm. (3″) broad, with many stout spines.—Sands along the coast, Delaware, New Jersey, and southward to Alabama and Mississippi. (South America.)

Burs about twice the size of those of *Cenchrus tribuloides*.

FIG. 407. **CENCHRUS ECHINATUS** Linn. Sp. Pl. 1050. 1753. COCK-SPUR.—A stout, erect, or ascending perennial 3–10 dm. (1°–3½°) high, with rather broad, flat leaves and cylindrical, dense spikes 8–12 cm. (3′–5′) long. Sheaths loose, glabrous; ligule short, densely ciliate-fringed, leaf-blades 10–30 cm. (4′–12′) long, 5–12 mm. (2½″–6″) wide, plane, acuminate, smooth or scabrous. Involucres (a) pilose or downy, 3- to 5- flowered (b), with many spines above and with a row of rigid barbed bristles near the base. The spikelet, with its unequal outer glumes, is shown by c, and the flowering glume and palea by d.—**Dry soil, fields and waste places, South Carolina to Florida and westward to Texas.** (Mexico and southward.) **March to September.**

FIG. 408. **ZIZANIOPSIS MILIACEA** (Michx.) Doell & Aschers. Fl. Bras. 2²: 12. 1871. (*Zizania miliacea* Michx. Fl. Bor. Am. 1: 74. 1803.) WATER MILLET.—A stout, erect, glabrous, semiaquatic grass 12–45 dm. (4°–15°) high, from extensively creeping rootstocks, with long, broad leaves and many-flowered panicles 30–45 cm. (12′–18′) long. Leaf blades 60 cm. (24′) long, 2 cm. (1′) wide or more, glabrous except on the scabrous margins. Spikelets staminate (c) below, and pistillate (*a*, *b*) above on each branch of the panicle, the former 6–8 mm. (3″–4″) long, awnless, the latter about 6 mm. (3″) long, the outer glume with an awn 2–6 mm. (1″–3″) long.—Swamps, etc., Georgia, Florida to Texas and (according to Riddell) northward to Ohio. May to August.

FIG. 409. **ZIZANIA AQUATICA** Linn. Sp. Pl. 991. 1753. WILD RICE, "REEDS."—A stout, erect, aquatic annual 9–30 dm. (3c–10c) high, with broad, flat leaves and large panicles 30–60 cm. (12'–24') long. Sheaths loose, glabrous, ligule thin, short; leaf-blades 30 cm. (12') long or more, 1–3 cm. (1'-1¼') wide, more or less scabrous above. Staminate spikelets (*c*) which are on the lower branches of the panicle 6–12 mm. (3"-6") long, awnless; the pistillate spikelets (*b*) which occupy the upper branches 8–24 mm. (4"-12") long, the outer one bearing an awn 24–48 mm. (12"-24") long. Grain linear, 10–16 mm. (5"-8") long. A dorsal view of the flowering glume is shown at *d* and the narrow palea and pistil of the fertile spikelet at *b*.—Swamps and shallow margins of sluggish streams and rivers, New Brunswick to Manitoba, southward to Florida and Texas. June to October.

The grain of this species is the favorite food of the reed bird, and it is cultivated to some extent by sportsmen with a view to attracting these and aquatic fowl. The stems are used by coopers for making the joints of barrels perfectly tight. This grass is the *Manomin* of the Chippewa Indians, who gather the grain for food.

FIG. 410. **SAVASTANA ALPINA** (Sw.) Scribn. Mem. Torr. Bot. Club. **5**: 34. 1894. (*Holcus alpinus* Sw. in Willd. Sp. Pl. **4** : 937. 1805: *Hierochloa alpina* R. and S. Syst. **2** : 515. 1817.) ALPINE VANILLA-GRASS.—A slender, glabrous, erect perennial 1.5-4.5 dm. (6′-20′) high, with flat leaves and contracted panicles 1.5-3 cm. (⅗′-1¼′) long. Sheaths shorter than the internodes; ligule less than 2 mm. (1″) long; lower leaf-blades 7-15 cm. (3′-6′) long, 2 mm. (1″) wide; the upper ones shorter. Spikelets 5-7 mm. (2½″-3½″) long; empty glumes very broadly ovate, obtuse, glabrous; flowering glumes (*b*) shorter, scabrous, ciliate on the margins, the first bearing an awn about 2 mm. (1″) long, the second with a more or less bent awn about 6 mm. (3″) long.—Greenland to Alaska and on the high mountains of New England and New York. (Northern Europe and Asia.) July to August.

Distinguished from *S. odorata* Scribn., by its narrower leaves, more compact and fewer-flowered panicles, and awned flowering glumes.

FIG. 411. **PHALARIS ARUNDINACEA** Linn. Sp. Pl. 55. 1753. REED CANARY-GRASS.—A stout, erect, glabrous, broad-leafed perennial, 6–15 dm. (2°–5°) high, with densely flowered panicles 6–16 cm. (2½′–6½′) long. Sheaths shorter than the internodes; ligule 2–6 mm. (1″–3″) long, obtuse; leaf-blades 8–25 cm. (3′–10′) long, 6–16 mm. (3″–8″) wide, acuminate, smooth or scabrous. Spikelets (*a*) 5–6 mm. (2½″–3″) long, with scabrous, 3-nerved outer glumes (*b*), one-fourth longer than the obtuse, pubescent flowering glume (*c*); the second pair of glumes less than one-half as long as the flowering glume, subulate, rigid, hairy.—Moist places and in shallow water, Nova Scotia to British Columbia, and southward to Maryland, Tennessee, Kansas, Arizona, and California. (Europe, Asia.) June to September.

This grass is valuable for cultivation on wet lands and flooded fields and its strong and extensively spreading rootstocks make it especially valuable for binding banks of rivers and ditches. The variety *picta*, known as ribbon grass, a form in which the leaves are variegated with green and white stripes, is cultivated for ornament.

FIG. 412. **PHALARIS LEMMONI** [illegible] U. S. Nat. Herb. 3: 42. [illegible] LEMMON'S CANARY-GRASS.—A rather slender, erect perennial [illegible] high, with short leaves and spike-like, cylindrical panicles [illegible] long. [illegible] than the internodes, glabrous; [illegible] long; leaf-blades plane or [illegible] long. [illegible] Spikelets [illegible] long, with [illegible] glumes [illegible] and lanceolate, acuminate-pointed [illegible] nearly as long as the outer ones; second pair of glumes [illegible] appressed to the flowering glume. Palea [illegible] long.—California. [illegible]

FIG. 113. **ARISTIDA CALIFORNICA** Thurb. in S. Wats. Bot. Calif. **2** : 289. 1880. HARE'S GRASS.—A slender, densely tufted, pubescent perennial, 1.5–2 dm. (6′–12′) high, with very narrow, involute leaves and racemose, few-flowered panicles 2–4 cm. (1′–1½′) long. Spikelets (*a*) 12–14 mm. (6″–7″) long; unequal; flowering glume (*b*) shorter than the first glume. Awns slender, nearly equal, 3–4 cm. (1′–1½′) long, twisted below into a long slender stipe, which is articulated with the flowering glume.—Desert places, Arizona to southern and Lower California. May.

VAR. FUGITIVA Vasey, Contr. Nat. Herb. **3** : 49. 1892. Differs from the species in the shorter internodes, more numerous short branches, giving the plant a densely bushy form, fewer spikelets, and longer empty glumes. The roots have but a slight hold in the sand in which it grows and it is torn up and driven across the plains by the wind like a tumble weed.

FIG. 414. **ARISTIDA DICHOTOMA** Michx. Fl. Bor. Am. **1**: 41. 1803. POVERTY GRASS.—A slender, erect, dichotomously branching annual 1.5–6 dm. ($\frac{1}{2}$°–2°) high, with narrow, usually involute leaves and slender, spike-like racemes or simple panicles 4–10 cm. ($1\frac{1}{2}'$–$4'$) long. Sheaths much shorter than the internodes, loose, glabrous; leaf-blades 2–8 cm. ($1'$–$3'$) long, less than 2 mm. ($1''$) wide, usually scabrous. Spikelets about 6 mm. ($3''$) long, with nearly equal outer glumes (*a*) and narrow, 3-awned flowering glumes (*b*); lateral awns 2 mm. ($1''$) long or less, the middle awn coiled at the base, 5–8 mm. ($2\frac{1}{2}''$–$4''$) long. The short, narrow palea is shown by *d*, and the lodicules and pistil by *c*.—Dry, sandy soil from Canada southward to Florida and westward to Ontario, Missouri, and Texas. August, September.

FIG. 415. **ARISTIDA BASIRAMEA** Engelm. Bot. Gaz. **9**: 76. 1884. TUFTED TRIPLE-AWN.—An erect, slender, smooth, much-branched perennial 1–4 dm. (4′–16′) high, with narrow, involute-setaceous leaves, and few-flowered, spike-like panicles 6–10 cm. (2½′–4′) long. Empty glumes (*a*) unequal: the first one-half to two-thirds as long as the second, which is 10–14 mm. (5″–7″) in length, both awn-pointed; flowering glume (*b*) shorter than the second glume; middle awn 12–18 mm. (6″–9″) long, coiled at the base, and divergent, the lateral awns about one-half as long as the middle one, erect or divergent.—Dry soil, Illinois and Manitoba to Virginia and Kansas. August, September.

FIG. 116. **ARISTIDA DESMANTHA** Trin. & Rupr. Agrostidea, 3: 109. 1842. WESTERN BUNCH-GRASS.—A slender, but rather rigid, erect, glabrous perennial 3–6 dm. (1°–2°) high, with narrow attenuate-pointed loosely-spread narrow panicles about 12 cm. (5') long. Ligule small, truncate; leaf-blades convolute, 15–30 cm. (6'–12') long, less than 1 mm. (½") wide, smooth beneath, scabrous above. Spikelets with the nearly equal outer glumes (b) about 12 mm. (6") long, exceeding the flowering glume (a), which bears three nearly equal reflexed, somewhat coiled awns about 24 mm. (12") long.—Dry soil, Kansas to Indian Territory, and Texas. August.

FIG. 117. **ARISTIDA SPICIFORMIS** Ell. Sk. Bot. S. C. and Ga. 1: 142. 1817.
SPIKE-LIKE POVERTY GRASS.—A stout erect perennial 5–9 dm. (1½–3 ft.) high, with rather long linear leaves and densely flowered, cylindrical, spike-like panicles. Leaf blades convolute, rigid, the radical ones 3 dm. (1°) long or more, **the cauline ones shorter. Empty glumes unequal, each awn-pointed and,** including the awns, 14–20 mm. (7"–10") long. Flowering glume (b) very slender, **linear, about 2 cm.** (1') long, twisted above to the spreading or divergent awns, which are about equal and 2 cm. (1') long, the middle awn longer than the lateral ones; **callus short, acute, barbate.—Moist pine barrens, Georgia and** Florida to **Mississippi. July to October.**

FIG. 418. **ARISTIDA OLIGANTHA** Michx. Fl. Bor. Am. 1: 41. 1803. PRAIRIE TRIPLE-AWN.—A tufted, much-branched native annual, with slender stems 2–4 dm. (8′–16′) high, loose sheaths, **narrow leaves, and lax, few-flowered panicles.** Sheaths glabrous; ligule a fringe of short hairs. **Leaf-blades** 5–15 cm. (2′–6′) long, involute-filiform, at least when dry; empty glumes (*a*) 3- to 5-nerved, subequal, awn-pointed; flowering glume (*b*) slightly exceeding the empty ones, scabrous, at least above; awns nearly equal, or the lateral ones slightly shorter than the middle one, strongly divergent, 2–5 cm. (1′–2′) long.—In poor, dry soil from the Middle States southward to Louisiana and Texas, and also in Oregon and California. July to October.

FIG. 419. **ARISTIDA LONGISETA** Steud. Syn. Pl. O. Gram. 420. 1855. DOG-TOWN GRASS.—A slender or sometimes rather stout, densely cæspitose, wiry perennial 2–4 dm. (8′–16′) high, with simple culms narrow, rather rigid, involute leaves, and contracted, few-flowered simple panicles 5–12 cm. (2′–5′) long. Spikelets (*a*) usually purplish, with very unequal empty glumes, the first about one-half the length of the second, which is 18–24 mm. (9″–12″) long, a little exceeding the flowering glume (*b*) which is terminated by three divergent, nearly equal awns varying in length from 5–10 cm. (2′–4′).—Dry soil, Minnesota to Kansas and Texas, and westward to British Columbia and Arizona. April to September.

Closely allied to *A. purpurea* Nutt., but readily distinguished by its simple and more rigid culmns, fewer-flowered and usually racemose panicles, erect and more rigid pedicels, larger spikelets and longer awns.

Fig. 120. **ARISTIDA HAVARDII** Vasey. Bul. Torr. Bot. Club, **13** : 27. 1886. HAVARD'S POVERTY GRASS.—A slender, erect, branching perennial, usually about 3 dm. (1°) high, with setaceous leaves and open panicles 8–12 cm. (3'–5') long, the flexuous branches divaricate-spreading. Leaf-blades setaceous, 7.5–15 cm. (3'–6') long, about six on the culm. Empty glumes (a) slightly unequal, about 10 mm. (5'') long, 1-nerved, acuminate; flowering glume (b) about equaling the empty glume; awns spreading, nearly equal, 12–14 mm (6''–7'') long.—Prairies, western Texas to New Mexico and Arizona. August to October.

FIG. 121. **ARISTIDA DIVERGENS** Vasey, Contr. U. S. Nat. Herb. **3**: 48. 1892. (*A. schiedeana* var. *minor* Vasey, Bul. Torr. Club. **13**: 28. 1886.) TEXAS POVERTY-GRASS.—A rather rigid, erect perennial 3–6 dm. (1°–2°) high, with narrow, involute leaves and diffuse panicles 10–16 cm. (4′–6′) long. Empty glumes (*a*) 6–8 mm. (3″–4″) long, the second slightly exceeding the first, bristle-pointed, and a little longer than the involute flowering glume (*b*). Awn 10–12 mm. (5″–6″) long, the lateral ones wanting or very short.—Arizona and Texas. August, September.

FIG. 422. **ARISTIDA FLORIDANA** (Chapm.) Vasey, Contr. U. S. Nat. Herb. **3**: 48. 1892. (*Streptachne floridana* Chapm. Fl. So. U. S. 554. 1860.) FLORIDA CURLY-BEARD.—A slender, erect, somewhat wiry perennial about 6 dm. (2°) high, with nearly filiform leaves and narrow panicles 30 cm. (12′) long. Sheaths hairy at the throat; leaf-blades elongated, convolute, smooth. Panicle erect, the branches in pairs, scattered. Spikelets (*a*) with nearly equal, purplish empty glumes and a strongly involute, linear flowering glume (*b*) tapering into a long, more or less curved or flexuous awn; lateral awns wanting.—Florida. September.

FIG. 423. **STIPA AVENACEA** Linn. Sp. Pl. 78. 1753. (*S. barbata* Michx. 1803.) BLACK OAT-GRASS.—A smooth, erect perennial 3–7.5 dm. (1°–2½°) high, with involute, filiform leaves, and open, few-flowered panicles 10–16 cm. (4′–6′) long. Spikelets 8–10 mm. (4″–5″) long; empty glumes (*a*) equal, glabrous, about 12 mm. (6″) long; flowering glume (*b*) slightly shorter, seabrous and minutely hairy at the apex, **black**, the sharp callus densely pilose; awn 3–5 cm. (1½′–2′) long, scabrous, twisted below, and usually twice geniculate.—Dry, open woodlands, etc., **Rhode Island to Ontario and Wisconsin and southward to Florida and Mississippi. April to July.**

FIG. 424. **STIPA AVENACEOIDES** Nash, Bul. Torr. Bot. Club, **22**: 423. 1895. FEATHER-GRASS.—A rather slender, erect, smooth perennial 6–12 dm. (2°–4°) high, with long involute-setaceous leaves and simple panicles 8–20 cm. (3′–8′) long. Sheaths about one half as long as the internodes, glabrous; leaf-blades glabrous, the basal ones about 3 dm. (1°) long, those of the culm shorter. Spikelets few, with acuminate empty glumes (*a*) 16–20 mm. (8″–10″) in length, flowering glumes (*b*), including the callus, 14–16 mm. (7″–8″) long, brown, with a ring of short brown hairs at the apex, otherwise smooth; callus 6–8 mm. (3″–4″) long, covered with appressed brown silky hairs, which increase in length toward the base of the glume; awn 8–10 cm. (3′–4′) long, pubescent below, twice geniculate.—Florida, in pine lands near Cassia, Lake County. March to July.

Distinguished from *Stipa avenacea* Linn., by its much longer empty glumes and larger flowering glume.

FIG. 425. **STIPA COMATA** Trin. & Rupr. Agrost. 3: 75. 1842. NEEDLE GRASS.—A rather stout, erect, cæspitose perennial 3–9 dm. (1°–3°) high, with mostly involute leaves and loosely-flowered panicles 16–24 cm. (6′–10′) long. Sheaths loose, the uppermost somewhat inflated and inclosing the base of the panicle, smooth; ligule conspicuous, acute, 4–6 mm. (2″–3″) long; leaf-blades roughened, the radical ones one-fourth to one-third as long as the culm, the leaves of which are much shorter. Spikelets with nearly equal long-attenuate-pointed empty glumes (*a*) about 24 mm. (12″) long, and thinly pubescent flowering glumes (*b*) about 12 mm. (6″) long; awn slender, 8–10 cm. (3′–4′) long, strongly flexuous or variously curled and twisted. The palea is shown by *c*.—Dry, sandy soil, British Columbia to California and eastward to the Dakotas and Nebraska. May to September.

A valuable range grass.

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FIG. 426. **STIPA OCCIDENTALIS** Thurb. U. S. Geol. Explor. 40th Par. 5: 380. 1871. Not in Wilkes U. S. Explor. Exped. **17**: 483. 1874. (*Stipa stri* Vasey, Bul. Torr. Bot. Club. **10**: 42. 1883. Not Lam. Tabl. Encycl. 1: 15 1791: *S. oregonensis* Scribn. U. S. Dept. Agr. Div. Agros. Bul. **17**: 130, *f.* 42 1899.) WESTERN FEATHER-GRASS.—A slender, erect, tufted perennial 3-5 dm. (12′–20′) high, with narrow, setaceously pointed leaves, short ligule, and contracted, erect panicles 8–16 cm. (3′–6′) long. Ligule 1–2 mm. (½″–1″) long Spikelets 10–12 mm. (5″–6″) long; empty glumes (*a*) about equal, thin-mem branaceous and carinate above, 3- to 5- nerved; flowering glume (*b*) 5-6 mm (2½″–3″) long, clothed throughout with a thin, short pubescence and with tw ciliate teeth at the apex; awn 24–36 mm. (12″–18″) long, pubescent or subplu mose and twisted in the lower half.—In dry soil, California to Washington.

FIG. 427. **STIPA HASSEI** Vasey, Contr. U. S. Nat. Herb. 1: 267. 1893. HASSE'S FEATHER-GRASS.—A slender, wiry, and densely tufted perennial 3–4.5 dm. (1°–1½°) high, with erect, setaceous leaves and narrow panicles 4–6 cm. (1½′–2½′) long. Sheaths close, striate; ligule very short; leaf-blades 10–20 cm. (4′–8′) long. Spikelets about 6 mm. (3″) long; empty glumes (*a*) nearly equal, the first 1- or faintly 3- nerved, the second strongly 3-nerved; flowering glume (*b*) about equaling the outer ones, thin-membranaceous, with 3 strong nerves, glabrous. Palea about one-half as long as the flowering glume. Awn 16–18 mm. (8″–9″) long, glabrous.—Dry soil, ridges, etc., southern California. April.

FIG. 428. **STIPA NEO-MEXICANA** (Thurber) Scribn. U. S. Dept. Agr. Div. Agros. Bul. **17**: 132, *f. 428*, 1899. (*S. pennata neo-mexicana* Thurber in Vasey. U. S. Dept. Agr. Div. Bot. Bul. **12**[2]: 8, *pl. 8.* 1891.) FEATHER-GRASS.—A rather stout, erect, densely tufted perennial 3–9 dm. (1°–3°) high, with involute leaves and narrow, racemose panicles 8–10 cm. (3′–4′) long. Empty glumes (*a*) nearly equal, long-setaceous-pointed 5- to 7- nerved, 3–4 cm. (1¼′–1¾′) long; flowering glume (*b*) 10–14 mm. (5″–7″) long, clothed throughout with a close appressed pubescence. Awn 8–12 cm. (3′–5′) long, plumose-hairy, excepting near the base. The palea is shown by *c*.—High northern slopes of the mountains of southern Colorado, New Mexico, Arizona, and Texas. May to September. A grass of some value as an ornamental.

Fig. 429. **STIPA PRINGLEI** (Beal) Scribn. Contr. U. S. Nat. Herb. **3** : 54. 1892. (*Oryzopsis pringlei* Beal, Bot. Gaz. **15** : 112. 1890.) PRINGLE'S FEATHER-GRASS.—A slender, erect, cæspitose perennial 6–12 dm. (2°–4°) high, with long, flat leaves and loosely few-flowered panicles 15–20 cm. (6′–8′) long. Basal leaves narrow, 4.5–6 dm. (1½°–2°) long, seabrous; cauline ones shorter, rigid; ligule short. Spikelets 8–10 mm. (4″–5″) long, with acute, 5-nerved empty glumes (*a*) and pubescent flowering glumes (*b*); awn slender, about 20 mm. (10″) long. The palea is shown by *c*.—Dry slopes, Texas to Arizona and California. (Mexico.) July to October.

Fig. 430. **STIPA VIRIDULA** Trin. Gram. Suppl. 39. 1836. FEATHER BUNCH-GRASS.—A slender or often rather stout, cæspitose, erect perennial 5–12 dm. (1⅔°–4°) high, with involute-pointed leaves and narrow, contracted panicles 12–20 cm. (5′–8′) long. Spikelets with nearly equal, subulate-pointed empty glumes (*a*) 6–9 mm. (3″–4½″) long, the lower 5- the upper 3- nerved flowering glume (*b*) one-fourth shorter than the empty glumes, 2-toothed at the apex, pubescent with short, scattered hairs, which form a thin crown at the apex. Palea (*c*) about one-half as long as the glume; awn about 24 mm. (12″) long, finally separating from the glume.—Colorado to Montana and westward.

This species is one of the most valuable hay grasses of the genus *Stipa* and does very well under irrigation.

Fig. 431. **STIPA MACOUNII** Scribn. Macoun Cat. Can. Pl. **2**: 390. 1890. (*S. richardsonii* A. Gray. 1857. Not Link. 1833.) MACOUN'S STIPA.—A slender, densely cæspitose perennial 3–6 dm. (1°–2°) high, with very narrow leaves and few-flowered panicles 4–10 cm. (½′–4′) long. Sheaths shorter than the internodes; ligule about 2 mm. (1″) long, obtuse; leaf-blades 5–13 cm. (2′–5′) long, 1–2 mm. (½″–1″) wide, scabrous, becoming involute-setaceous in drying. Empty glumes (*a*) about 4 mm. (2″) long, obtuse, glabrous, the pubescent flowering glume (*b*) a little shorter than the empty ones; awn 8–10 mm. (4″–5″) long. The palea is shown by *c*.—Maine to Lake Superior and northward. July, August.

FIG. 432. **STIPA TENUISSIMA** Trin. Gram. Suppl. 36. 1836. SLENDER FEATHER-GRASS.—A slender, densely tufted perennial 5–8 dm. ($1\frac{1}{3}°$–$2\frac{1}{3}°$) high, with long, filiform leaves and narrow panicles 15–20 cm. (6′–8′) long. Leaf-blades filiform, scabrous, the radical ones equaling the culm, cauline leaves similar, the uppermost sheathing the base of the panicle. Empty glumes (*a*) subulate-pointed, the first 12–18 mm. (6″–9″) long, the second 5–8 mm. ($2\frac{1}{2}$″–4″) long; flowering glume (*b*) about 2.5 mm. ($1\frac{1}{4}$″) long, minutely punctate, apex constricted and crowned with a few hairs, sparsely pubescent at the base and on the callus; awn flexuous, 7–8 cm. ($2\frac{1}{2}$′–3′) long.—Limestone hills, etc., Texas and New Mexico. (Mexico.) August, September.

FIG. 433. **STIPA BLOOMERI** Boland. Proc. Calif. Acad. Sci. **4**: 168. 1872. (*S. sibirica* Thurb. Not Lam.) BLOOMER'S STIPA.—A slender, densely cæspitose perennial 3–9 dm. (1°–3°) high, with long, narrow, or involute leaves and more or less open panicles 12–24 cm. (5′–10′) long. Spikelets 8 mm. (4‴) long; empty glumes (*a*) acuminate, 3-nerved, minutely seabrous, and one-fourth longer than the flowering glume (*b*), which becomes brownish at maturity, clothed with long, rather coarse hairs; awn 12–18 mm. (6‴–9‴) long, strongly pubescent below, scabrous above. The palea is shown by *c*.—California and Montana.

FIG. 434. **STIPA CORONATA** Thurber in S. Wats. Bot. Calif. **2**: 287. 1880. CRESTED FEATHER-GRASS.—A stout, erect perennial 12–18 dm. (4°–6°) high, with flat leaves, the lower ones often 9 dm. (3°) long, and erect, narrow, and rather densely flowered panicles 3–4 dm. (12′–16′) long. Spikelets with unequal, acuminate-pointed empty glumes (*a*), the lower one about 16 mm. (8″) long, 3-nerved, the upper one 12 mm. (6″) long, 5-nerved, acuminate; flowering glume (*b*), including the short curved callus and long hairy crown, 10 mm. (5″) long, clothed with silky, shining hairs, the upper ones longer and more numerous, forming a corona 4 mm. (2″) long; awn slender, about 2 cm. (1′) long, minutely scabrous.—Sandy plains and hillsides, Arizona and California. March to September.

FIG. 435. **STIPA RICHARDSONI** Link, Hort. Berol. **2**: 245. 1833. RICHARDSON'S FEATHER-GRASS.—A slender, erect perennial 6–9 dm. (2°–3°) high, with narrow leaves and nodding, open, few-flowered panicles 7–12 cm. (3′–5′) long. Spikelets (*a*) 8–9 mm. (4″–4½″) long, broadly lanceolate, acute; empty glumes unequal, the lower about 9 mm. (4½″) long, the upper one-fourth shorter, both 3-nerved; flowering glume (*b*) 6 mm. (3″) long, sparsely hairy, brown; awn slender, scabrous, 12–20 mm. (6″–10″) long. The palea is shown by *c*.—Dry hillsides and open woods, South Dakota, Colorado, Wyoming, Montana, and Canada. July to September.

FIG. 436. **STIPA THURBERIANA** C. V. Piper, U. S. Dept. Agr. Div. Agros. Cir. **27** : 10. 1900 (*Stipa occidentalis* Thurb. in Wilkes U. S. Explor. Exped. **17** : 483. 1874. Not U. S. Geol. Explor. 40th Par. **5**: 380. 1871.) WESTERN NEEDLE-GRASS.—A slender, erect perennial 3–6 dm. (1°–2°) high, with rigid, involute leaves, long ligule, and contracted panicles 6–12 cm. (2¼′–5′) long. Ligule 4–6 mm. (2″–3″) long. Spikelets about 10 mm. (5″) long; empty glumes (*a*) somewhat unequal, the first 10 mm. (5″) long, 3- to 5- nerved, slightly exceeding the 3-nerved second one; flowering glumes (*b*) 6–7 mm. (3″–3½″) long, pubescent, with appressed hairs, brownish when mature, especially below; awn 3 cm. (1¼′) long, plumose below. Palea (*c*) one-fourth shorter than the flowering glume.—**Dry soil and rocky banks** of the plains and foothills, Nevada, California, Oregon, and Washington. May to July.

The grass described as *Stipa occidentalis* by Thurber in Wilkes U. S. Explor. Exped. 1874, and which has been considered as typical of that species, is distinct from *Stipa occidentalis* Thurber in U. S. Geol. Surv. 40th Par. 1871. The true *Stipa occidentalis* was described by Vasey as *S. stricta* (*S. oregonensis* Scribn.), a grass at once distinguished from *S. thurberiana* by its very short ligule.

FIG. 437. **STIPA VASEYI** Scribn. U. S. Dept. Agr. Div. Agros. Bul. **11**: 46. 1898. (*Stipa viridula* var. *robusta* Vasey. Not *Stipa robusta* Nutt.) SLEEPY GRASS.—**A stout, erect perennial** 12–18 dm. (4°–6°) high, with long, flat leaves and erect, densely flowered panicles 30–45 cm. (12′–18′) long. Spikelets about 10 mm. (5″) long; empty glumes (*a*) firm in texture, minutely but distinctly scabrous on the back; flowering glumes (*b*) pubescent, 6–7 mm. (3″–3½″) long. The palea is shown by *c*.—Colorado, New Mexico, southern California. (Mexico.) **June to September.**

This grass, although producing a large bulk of stems and leaves, is regarded with suspicion by stockmen. It is said that when it is eaten in the fresh state by horses, it has a narcotic or poisonous effect, causing the animals to become crazed or "locoed," its action resembling that of the deadly loco weed (*Astragalus mollissimus*).

FIG. 438. **STIPA SCRIBNERI** Vasey, Bul. Torr. Bot. Club, **11**: 125. 1884. SCRIBNER'S FEATHER-GRASS.—A stout, erect, smooth perennial 4.5–7.5 dm. ($1\frac{1}{2}°$–$2\frac{1}{2}°$) high, with rather long, narrow, involute-pointed leaves and contracted panicles 12–16 cm. ($5'$–$6\frac{1}{2}'$) long. Spikelets 12–14 mm. ($6''$–$7''$) long; empty glumes (*a*) unequal, the first 12–14 mm. ($6''$–$7''$) long, the second about 10 mm. ($5''$) long, both 3-nerved, acuminate; flowering glumes (*b*) 6–10 mm. ($3''$–$5''$) long and crowned with a tuft of rather long hairs; awn rather slender, 16–18 mm. ($8''$–$9''$) long. Palea (*c*) less than 2 mm. ($1''$) long, obtuse.—**Dry soil of mesas and canyons, Colorado and New Mexico.** June to September.

FIG. 439. **STIPA PARISHII** Vasey, Bot. Gaz. 7: 32. 1882. PARISH'S FEATHER-GRASS.—A rather stout, erect, tufted perennial 3–4.5 dm. (1°–1½°) high, with rigid, involute leaves and open, erect panicles about 15 cm. (6′) long. Spikelets 12–14 mm. (6″–7″) long; empty glumes (*c*) linear-lanceolate, 3-nerved, smooth, the first 12–14 mm. (6″–7″) long, the second about 2 mm. (1″) shorter, nearly twice as long as the flowering glume (*b*), which is densely covered with long, silky hairs, and bidentate at the apex (*d*), the teeth less than 2 mm. (1″) long; awn about 18 mm. (9″) long, smooth above, scabrous below.—Dry soil, mountains of southern and Lower California. June to August.

FIG. 440. **STIPA SPECIOSA** Trin. & Rupr. Agrostidea. 3: 45. 1842. SHOWY FEATHER-GRASS.—A rather stout, erect, caespitose perennial 3-6 dm. (1°-2°) high, with long, narrow, radical leaves and erect, contracted panicles 12-16 cm (5′-6½′) long. Spikelets 16-18 mm. (8″-9″) long; empty glumes (a) nearly equal acuminate, hyaline, the first 3-, the second 5- to 7- nerved. flowering glume densely bearded, 10-12 mm. (5″-6″) long, silky pubescent throughout, slightly but distinctly 2-toothed; awn 3-4 cm. (1½′-3½′) long, plumose below the middle with white, silky hairs 6 mm. (3″) long, smooth above.—Dry soil, Colorado and Arizona to southern and Lower California. (South America.) April to September.

FIG. 441. **ORYZOPSIS WEBBERI** (Thurb.) Vasey, Bul. Torr. Bot. Club, **15:** 49. 1888. (*Eriocoma webberi* Thurb. in S. Wats. Bot. Calif. **2:** 283. 1880.)—A slender, wiry, and densely tufted perennial 1–2 dm. (4′–8′) high, with rigid, pungent-pointed, convolute leaves and narrow, few-flowered panicles 2–5 cm. (¾′–2′) long. Spikelets about 8 mm. (4″) long; empty glumes (*a*) acuminate-pointed; flowering glumes (*b*) 6 mm. (3″) long, 5-nerved, minutely 2-lobed at the apex, covered with copious, silky, white hairs; palea nearly equaling the glume and similarly hairy; awn very slender, about 4 mm. (2″) long, very deciduous.—In very dry soil, Nevada and California. July.

FIG. 442. **ORYZOPSIS JUNCEA** (Michx.) B. S. P. Prel. Cat. N. Y. 67. 1888. (*Stipa juncea* Michx. Fl. Bor. Am. 1: 54. 1803; *Oryzopsis canadensis* Torr. 1843.) SMALL MOUNTAIN RICE.—An erect, glabrous, slender, tufted perennial 1.5–6 dm. (½°-2°) high, with erect, involute leaves and narrow panicles 2–5 cm. (¾′-2′) long. Sheaths crowded below, shorter than the internodes; ligule 2 mm. (1″) long, decurrent; leaf-blades filiform, smooth or scabrous. Spikelets 3-4 mm. (1½″-2″) long; empty glumes (*a*) about equal, glabrous, whitish; flowering glume (*b*) about equaling or slightly exceeding the empty glumes, pubescent with short, appressed, silky hairs; awn deciduous, 2 mm. (1″) long or less.—Dry, rocky soil and open woodlands, Maine to British Columbia southward to Pennsylvania and Colorado. May to August.

FIG. 443. **MUHLENBERGIA TRICHOPODES** (Ell.) Chapm. Fl. So. U. S. 558. 1860. (*Agrostis trichopodes* Ell. Sk. Bot. S. C. and Ga. 1: 135, *pl. 8 f. 1.* 1817.) BUNCH HAIR-GRASS.—A slender, rather rigid perennial 6–9 dm. (2°–3°) high, with very narrow, flat or involute leaves and capillary panicles nearly 30 cm. (12′) long. Spikelets (*a*) linear, on spreading pedicels; empty glumes nearly equal, hardly more than one-half the length of flowering glume (*c*), which is slightly hairy at the base, the two lateral nerves percurrent, terminated by a short, straight awn. Palea (shown by *b*) equaling the flowering glume.—Dry pine barrens, North Carolina to Florida and westward to Texas. July to October.

Fig. 444. **MUHLENBERGIA COMATA** (Thurb.) Benth. Journ. Linn. Soc. **19**: 83. 1881. (*Vaseya comata* Thurb. Proc. Acad. Nat. Sci. Phila. **1863**: 79. 1863.) WOOLLY DROP-SEED.—A rather stout or slender upright perennial 3–9 dm. (1°–3°) high, with flat leaves and densely flowered, more or less lobed or interrupted panicles 8–10 cm. (3′–4′) long. Spikelets about 3 mm. (1½″) long. sessile or nearly so; empty glumes (*a*) narrowly lanceolate, acute; flowering glume (*b*) nearly as long as the empty glumes, somewhat 2-toothed at the apex, surrounded at the base with copious white hairs which nearly equal the glume; awn 6–8 mm. (3″–4″) long, somewhat flexuous.—Rather moist broken ground, in mountains and foothills, Nebraska to Oregon, south to Colorado and California. July to September.

FIG. 445. **MUHLENBERGIA DUMOSA** Scribn. in Vasey, Contr. U. S. Nat Herb. **3**: 71. 1892. (*Sporobolus depauperatus* (?) Scribn. Bul. Torr. Bot. Club, **9**: 103. 1882.) SHRUBBY DROP-SEED.—A stout, woody, much-branched, and leafy perennial, with erect or ascending culms 6–9 or 12 dm. (2°–3° or 4°) long, and slender, simple panicles 1–3 cm. (½′–1¼′) long. Leaf-blades filiform, very numerous, 5 cm. (2′) long. Spikelets about 3 mm. (1¼″) long; empty glumes (*a*) nearly equal, about 1 mm. (½″) long; flowering glume (*b*) narrow, terete, prominently 3-nerved, pubescent below, tipped with an awn 4 mm. (2″) long. Palea rather longer than the glume, pilose.—Rocky canyons and along streams in the mountains of Arizona. (Mexico.) May, June.

FIG. 446. **MUHLENBERGIA MONTICOLA** Buckley. Proc. Acad. Nat. Sci. Phila. **1862**: 91. 1862.—A slender, wiry, much-branched perennial 3–6 dm. (1°–2° high, with short, narrow leaves and strict (or in anthesis, spreading) panicles 8–20 cm. (3′–8′) long. **Spikelets sessile, 4 mm. (2″) long; empty glumes** (*a* unequal, not awned or pointed; the second one 3 mm. (1½″) long, obtuse; the first shorter, both 1-nerved; **flowering glume** (*b*) 3 mm. (1½″) long, pilose near **the base, and tipped with a very slender flexuous awn 10–15 mm.** (5″–7½″) long.— **Dry soil, Texas to Arizona. (Mexico.) August to October.**

FIG. 447. **MUHLENBERGIA LEMMONI** Scribn. Contr. U. S. Nat. Herb. **3**: 70. 1892. LEMMON'S DROP-SEED.—A leafy, ascending, wiry perennial 3–6 dm. (1°–2°) high, much branched at the base, with narrow, erect leaves and densely flowered, interrupted panicles 6–8 cm. (2½′–3¼′) long. Leaf-blades 2.5–5 cm. (1′–2′) long and about 2 mm. (1″) wide. Spikelets about 4 mm. (2″) long; empty glumes (*a*) lanceolate-acuminate, 2 mm. (1″) long or more; flowering glume (*b*) about 3 mm. (1½″) long, broadly lanceolate, and densely pubescent below; awn about 4 mm. (2″) long.—Mountains, Texas to Arizona. September.

FIG. 448. **MUHLENBERGIA CAPILLARIS** (Lam.) Trin. Unifl. 191. 1824. (*Stipa capillaris* Lam. Tabl. Encycl. **1**: 158. 1791.) BEARDED HAIR-GRASS.—A rigid, erect, glabrous, and unbranched perennial 6–12 dm. (2°–4°) high, with long, involute leaves and showy, capillary panicles 15–45 cm. (6′–18′) long. Spikelets about 4 mm. (2″) long, with nearly equal empty glumes (*a*) one-fourth to one-half as long as the flowering glume, awned or awnless; flowering glume (*b*) about 4 mm. (2″) long, narrow, bearing a slender awn 2 to 4 times its own length.—Dry, sandy, or rocky soil, open woods, etc., Massachusetts to Florida and westward to Texas. August to October.

FIG. 449. **MUHLENBERGIA PARVIGLUMIS** Vasey, Contr. U. S. Nat. Herb. 3: 71. 1892. SMALL-GLUMED DROP-SEED.—A slender, erect perennial 3–6 dm. (1°–2°) high, often branching, with rather rigid, narrow leaves and narrow panicles 8–14 cm. (3′–5½′) long. Ligule short, fimbriate: leaf-blade involute, 2–10 cm. (1′–4′) long. Spikelets about 3 mm. (1½″) long: empty glumes (*a*) nearly equal, obtuse, one-fourth to one-fifth as long as the flowering glume (*b*), which is 3 mm. (1½″) long, with 2 sharp teeth at the apex, bearing between the teeth a slender awn 12–20 mm. (6″–10″) long.—On dry hillsides, Texas. September, October.

FIG. 450. **LYCURUS PHLEOIDES** H. B. K. Nov. Gen. et Sp. Pl. 1: 142. *t.* 45. 1815. TEXAN TIMOTHY.—A slender, wiry perennial 2–4.5 dm. (8′–18′) high, much branched and often geniculate at the base, with narrow, long-pointed leaves and cylindrical, spike-like panicles 3–6 cm (1¼′–2½′) long. Spikelets 4 mm. (2″) long, with awned glumes (*a*), the first glume (*c*) often terminating in two unequal awns, the flowering glume (*b*) terminating in an awn as long as itself.—Dry soil on the plains and mesas, Colorado to Texas and westward to New Mexico and Arizona. (Mexico.) May to October.

FIG. 451. **PHLEUM ALPINUM** Linn. Sp. Pl. 59. 1753. ALPINE TIMOTHY.—A glabrous, erect perennial 1.5–4.5 dm. (6′–18′) high, with flat leaves and cylindrical, ovoid, or oblong, spike-like panicles 1–5 cm. (½′-2′) long. Sheaths shorter than the internodes, striate; ligule short, obtuse; leaf blades spreading, acute, glabrous, except on the scabrous margins, 4–5 mm. (2″-2½″) wide. Empty glumes (*a*) short-awned, 3–4 mm. (1½″-2″) long, strongly ciliate on the keel; flowering glume (*b*) 5-nerved, subcrenulate at the apex, the midnerve extending as a short point.—Moist soil in the mountains, Labrador to Alaska, south to New England, Arizona, and California. (Europe, Asia, South America.) June to September.

FIG. 452. **ALOPECURUS ALPINUS** J. E. Smith in Sowerby's Engl. Bot. *t.* 1126. 1803. ALPINE FOXTAIL.—A glabrous, erect perennial 1–6 dm. (4′–24′) high with flat leaves and cylindrical, ovoid, densely flowered panicles 1–3 cm. (½′–1′) long. Sheaths generally shorter than the internodes, loose, often inflated; ligule 2–4 mm. (1″–2″) long; leaf-blades 1–8 cm. (½′–3′) long, 2–6 mm. (1″–3″) wide, smooth beneath, slightly scabrous above. Spikelets 4 mm. (2″) long, with obtuse, densely villous outer glumes (*a*) about the length of the flowering glume (*b*), which is pubescent near the apex, glabrous below, bearing on the back, just below the middle, a slender awn which slightly exceeds the glume.—**Moist places, Greenland, Labrador, to Alaska.** (Arctic regions of Europe and **Asia.) July, August.**

FIG. 153. **SCHMIDTIA SUBTILIS** Tratt. Fl. Oesterr. **1**: 12. 1816. (*Coleanthus subtilis* Seid. in R. & S. Syst. **2** : 276. 1817.) MOSS-GRASS.—A low, moss-like grass growing in loose tufts 2–6 cm. (¾′–2½′) high, with short, recurved leaves, inflated sheaths, and simple panicles 1–2 cm. (½′–1′) long. Spikelets (*a*, *b*) hardly 1 mm. (½″) long, in small, umbellate clusters; flowering glume acuminate, membranaceous, except the hispid, excurrent midnerve. Palea (*c*) 2- to -3 lobed or toothed above, similar to the flowering glume in texture.—Wet, muddy places, Washington and Oregon. (Northern Europe.) September, October.

FIG. 454. **SPOROBOLUS UNIFLORUS** (Muhl.) Scribn. & Merrill, U. S. Dept. Agr. Div. Agros. Cir. **27**: 5. 1900. (*Sporobolus serotinus* A. Gray, Man. 577. 1848; *Agrostis serotina* Torr. Fl. U. S. 1: 88. 1824; *Poa uniflora* Muhl. Gram. 152. 1817.) LATE DROP SEED. A slender, erect perennial 1.5–4.5 dm. (6′–18′) high with very narrow, flat leaves and delicate, open panicles 6–18 cm. (2½′–7′) long. Sheaths short, confined to the lower part of the culm; ligule less than 1 mm. (1/25″) long, truncate; leaf-blades one third to one half as long as the culm, 1 mm. (1/25″) wide or less, plane, slightly scabrous above. Spikelets about 1.5 mm. (1/16″) long, with the outer glumes (*a*) obtuse, smooth or somewhat scabrous; flowering glume (*b*) acuminate, twice exceeding the outer ones. The grain is shown by *c*.—Bogs and wet, sandy soil, Maine to New Jersey and westward to Michigan. **August, September.**

FIG. 455. **SPOROBOLUS JUNCEUS** (Michx.) Kunth, Rev. Gram. **1**: 68. 1835. (*Agrostis junceus* Michx. Fl. Bor. Am. **1**: 52. 1803.) RUSH GRASS.—A glabrous, erect, slender, wiry perennial 3-6 dm. (1′-2′) high, with setaceous leaves, the basal ones 12-24 cm. (5′-10′) long, and open panicles 6-14 cm. (2⅓′-5½′) in length. Spikelets (*a*) 2.5-3 mm. (1¼″-1½″) **long, with very unequal empty glumes, the** first one-fourth to one-third as long as the second, which equals the **subacute** flowering glume (*b*). Palea equaling the glume.—Dry, sandy soil. Virginia to Florida and westward to Texas. February to December.

Common throughout the Southwestern States, but is of little agricultural value. This and *Aristida stricta* are known throughout the South as "wire grass."

FIG. 456. **SPOROBOLUS CRYPTANDRUS** (Torr.) A. Gray, Man. 576. 1848. (*Agrostis cryptandra* Torr. Ann. Lyc. N. Y. **1**: 151. 1824.) SAND RUSH-GRASS.—An erect, glabrous, cæspitose perennial 4–7 dm. (16′–27′) high, with flat leaves 6–12 cm. (2½′–5′) long, and open panicles 12–20 cm. (5′–8′) long. Spikelets 2–3 mm (1″–1⅓″) long, nearly sessile; empty glumes (*a*) acute, the first one-half as long as the second, which is as long as the flowering glume (*b*).—Sandy soil, Massachusetts and Pennsylvania, westward to Montana and Washington, southward to Texas and New Mexico. (Mexico.) June to September.

This is a common species in the West and is regarded as an important forage plant, as it is well liked by stock.

Var. FLEXUOSA Thurb., in S. Wats. Bot. Calif. **2**: 269. 1880. Axis of panicle elongated, flexuous, the branches slender and sometimes reflexed.—California to Utah, New Mexico, and Texas. (Mexico.)

FIG. 457. **SPOROBOLUS DOMINGENSIS** (Trin.) Kunth, Enum. Pl. **1**: 214. 1833. (*Vilfa domingensis* Trin. in Sprengel, Neue Entd. **2**: 59. 1821; *Agrostis domingensis* Schultes.) WEST INDIAN RUSH-GRASS.—An erect, glabrous, branching perennial, usually about 3 dm. (1°) high, with rather rigid, flat, attenuate-pointed leaves and narrow, many-flowered panicles 5–6 cm. (2′–2¼′) long. Sheaths about equaling the internodes, subcompressed, smooth; leaf-blades glabrous or sparingly pilose on the upper surface. Spikelets nearly 2 mm. (1″) long; empty glumes (*a*) unequal, the first one-half as long as the second, which equals the flowering glume; flowering glume (*b*) 1-nerved, acute. Palea obtuse, scarcely shorter than the glume.—Saline soil, near the coast Florida. (West Indies.) June to September.

FIG. 458. **SPOROBOLUS WRIGHTII** Scribn. Bul. Torr. Bot. Club, **9**: 103. 1882.
SACCATON.—A stout, erect perennial 10–18 dm. (3°–6°) high, with long leaves and many-flowered, open panicles 30–60 cm. (12′–20′) long. Spikelets (*a*) 2 mm. (1″) long, with thin, unequal empty glumes, the second nearly twice as long as the first; flowering glume (*b*) similar in texture to the empty glumes, smooth about the same length as the second glume. Palea lanceolate, cleft at the apex. The grain is shown by *c*.—"Adobe" soil, Texas, New Mexico, and Arizona. July to September.

This species grows in great clumps, producing a large quantity of coarse but valuable hay. It is especially valuable for saline bottoms subject to floods

FIG. 459. **SPOROBOLUS BUCKLEYI** Vasey, U. S. Dept. Agr. Div. Bot. Bul. 12[2]: 17, *pl. 17.* 1891. BUCKLEY'S RUSH-GRASS.—A rather stout, erect perennial 6–9 dm. (2°–3°) high, with long flat leaves and erect open panicles 20–35 cm. (8′–14′) long. Sheaths mostly exceeding the internodes; ligule a minute tawny fringe; leaf-blades 15–38 cm. (6′–15′) long. Spikelets (*a*) about 1.5 mm. (¾″) long, with acute, unequal, thin, empty glumes, the second being about twice as long as the first; flowering glume (*b*) acuminate, hyaline, 1-nerved, slightly exceeding the second glume. Palea lanceolate, obscurely 2-keeled, 1 mm. (½″) long. The grain is shown by *c*.—Texas. (Mexico.) July.

FIG. 460. **SPOROBOLUS JONESII** Vasey, Bot. Gaz. 6: 297. 1881. JONES RUSH-GRASS.—A slender, wiry, densely tufted, erect perennial 3-4.5 dm. (1'-1½') high with numerous short, rigid, involute, radical leaves, and more or less spreading panicles 3-6 cm. (1¼'-2½') long. Spikelets (*a*) about 3 mm. (1⅛") long, with nearly truncate or erose-dentate empty glumes (*c*, *d*), which are one-third to one-half as long as the acute flowering glume (*b*), which is similar to the palea in texture, firm membranaceous, finely scabrous-pubescent below. Floret (*b*) with a distinct callus.—Soda Springs, near Summit, California. July.

FIG. 461. **SPOROBOLUS LIGULATUS** Vasey & Dewey, Contr. U. S. Nat. Herb. 3: 518. 1894.—A slender, smooth, upright perennial, 3–4.5 dm. (1°–1½°) high, with narrow, flat leaves, and contracted panicles 8–12 cm. (3′–5′) long. Ligule 4–6 mm. (2″–3″) long, lanceolate; leaf-blades flat or convolute 1–3 dm. (4′–12′) long. **Spikelets** (*a*) 3–4 mm. (1½″–2″) long, subterete, with obtuse, nearly equal empty glumes (*b*), which are about one-half as long as the smooth flowering glume (*c*), which is obscurely 3- to 5- nerved, sub obtuse.—Canyons, western Texas. September.

FIG. 462. **SPOROBOLUS NEALLEYI** Vasey, Bul. Torr. Bot. Club, 15: 49. 1888. NEALLEY'S RUSH-GRASS.—A pale green, slender, densely tufted, erect, perennial 1.5–5 dm. (6′–20′) high, with more or less villous sheaths, rigid, flat, spreading leaves 4–10 cm. (1½′–4′) long, and open panicles 3–8 cm. (1¼′–3′) long. Leaf-blades rigid, involute, divaricate, 1–3 cm. (½′–1¼′) long, pilose at the throat. Spikelets (*a*, *b*) about 2 mm. (1″) long, with narrow, empty glumes, the first about one-half as long as the second, which nearly equals the flowering glume.—Habitat not known. Western Texas and New Mexico. July.

FIG. 463. **SPOROBOLUS TEXANUS** Vasey, Contr. U. S. Nat. Herb. 1: 57. 1890. TEXAN DROP-SEED.—A rather slender, rigid perennial about 3 dm. (1°) high, with stiff, flat leaves 4–6 cm. (1½′–2½′) long, and open, capillary panicles 10–16 cm. (4′–6′) long. Sheaths clothed with loose, white hairs; leaf-blades light green, scabrous above. Spikelets (*a*) about 2 mm. (1″) long, on capillary, diverging pedicels, with unequal empty glumes, the first about one-half as long as the second, which equals the flowering glume (*b*). The grain is shown by *c*.—Salt marshes, etc., Kansas to Texas. July, August.

Closely allied to *Sporobolus asperifolius* Thurb., but readily distinguished from that species by its very unequal empty glumes.

FIG. 464. **SPOROBOLUS ASPERIFOLIUS** (Nees & Mey.) Thurb. in S. Wats. Bot. Calif. **2**: 269. 1880. (*Vilfa asperifolia* Nees & Meyen, in Trin. Agrostidea 1: 73. 1840.) ROUGH-LEAFED SALT-GRASS.—A slender, much-branched, leafy perennial 1–3.5 dm. (4′–14′) high, with diffuse panicles 6–10 cm. (2½′–4′) long. Spikelets 1–1.5 mm. (¼″–¾″) long, with nearly equal, acute empty glumes (*a*), two-thirds as long as the obtuse, mucronate flowering glume (*b*). The grain is shown by *c*.—Alkaline soil, Assiniboia to the Dakotas and Missouri, westward to British Columbia, Arizona, and California. June to September.

This species grows well on strongly alkaline soil, and may prove valuable for propagation on such lands.

FIG. 465. **SPOROBOLUS THURBERI** Scribn. U. S. Dept. Agr. Div. Agros. Bul. 11: 48, *fig.* 5. 1898. THURBER'S RUSH-GRASS.—A slender, very much branched, and leafy perennial 1.5–2.5 dm. (6′–10′) high, from creeping rootstocks, with contracted, linear, long-exserted panicles 3–5 cm. (1¼′–2′) long. Lower sheaths short and crowded, the upper ones shorter than the internodes. Leaf-blades 12–16 mm. (6″–8″) long, convolute, setaceous, rigid. Spikelets straw-colored, 4–5 mm. (2″–2½″) long; empty glumes (*a*, *a′*) acute, about one-third shorter than the flowering glume (*b*, *c*), which is pilose for half its length and mucronate-pointed. Palea (*d*) very acute, strongly 2-nerved, pilose on the back, equaling the glume.—New Mexico. (?)

FIG. 466. **SPOROBOLUS VAGINÆFLORUS** (Torr.) Wood, Classbook, 775. 1861. (*Vilfa vaginæflora* Torr. in Trin. Agrost. **1**: 34. 1840; *Sporobolus minor* Vasey. 1890. SOUTHERN POVERTY-GRASS.—A slender, cæspitose annual 1.5 to 4 dm. (6′–16′) high, with very narrow, short, leaves and simple, few-flowered, terminal and axillary, spike-like panicles, which are about 2 cm. (1′) long and mostly inclosed in the somewhat inflated leaf-sheaths. Spikelets 2–4 mm. (1″–2″) long, empty glumes (*e*) unequal, acute or acuminate; flowering glume (*f*) scabrous or sometimes nearly smooth.—Dry fields and waste places, Vermont to South Dakota and Wyoming, southward to Georgia and Texas. **August, September.**

VAR. NEGLECTUS (Nash) has more spreading culms, shorter and usually obtuse flowering which are glabrous or pilose below.—Same distribution as the species *a* and *c* outer glumes, *b* and *d* florets of the variety.

FIG. 467. **SPOROBOLUS UTILIS** Torr. Pac. R. R. Rept. 5[2]: 365. 1857. APAREJO GRASS.—A slender, wiry, much-branched perennial 15–50 cm. (6′–20′) high, with short spreading or recurved, involute leaves and narrow, simple, few-flowered panicles. Spikelets about 2.5 mm. (1¼″) long, with the empty glumes (*a*) abont one-half the length of the obtuse flowering glume (*b*). The grain is shown by *c*.—Swampy places, along mountain streams, western Texas to Nevada and southern California. (Mexico.) January to December.

Used for stuffing *aparejos*, or pack saddles, a purpose to which its toughness and elasticity especially adapt it.

FIG. 468. **SPOROBOLUS SIMPLEX** Scribn. U. S. Dept. Agr. Div. Agros. Bul. **11**: 48, *f. 6.* July, 1898. MOUNTAIN DROP-SEED.—A low, densely cæspitose leafy annual 0.5–1.5 dm. (2′–6′) high, with smooth culms, short, flat leaves, and linear panicles 2–4 cm. (¾′–1¼′) long. Spikelets 2-2.3 mm. (1″–1¼″) long, with broadly obtuse or truncate empty glumes (*a*), less than 1 mm. (½″) long, minutely scabrous above, about one-half as long as the 3-nerved mucronate-pointed flowering glume (*b*), which is scabrous above. The grain is shown by *c*.—Moist places in the mountains of Colorado and Idaho. July to September.

Related to *S. gracillimus* Thurb., but readily distinguished from that species by its broader, more rigid leaves, scabrous panicle-branches, and generally stouter habit.

FIG. 469. **SPOROBOLUS FILIFORMIS** (Thurb.) Scribn. U. S. Dept. Agr. Div. Agros. Bul. **17**: 173, *f. 469.* 1899. (*Vilfa depauperata filiformis* Thurb. in S. Wats. King's Explor. 40th Par. **5**: 376. 1871.) SLENDER RUSH-GRASS.—A very slender, densely tufted annual 0.8–3 dm., usually about 1.5 dm. (3′–12′, usually 6′) high, with short, narrow leaves, scape-like culms, and linear, few-flowered panicles. Spikelets about 2 mm. (1″) long, empty glumes (*a*, *c*, *d*) unequal, 1-nerved, shorter than the flowering glume (*b*). The grain is shown by *e*.—Moist soil in the mountains, Washington to California and eastward to (?) Utah and Colorado. July to September.

FIG. 470. **SPOROBOLUS VIRGINICUS** (Linn.) Kunth, Rev. Gram. 1: 67. 1835. (*Agrostis virginica* Linn. Sp. Pl. 63. 1753.) SEASIDE RUSH-GRASS.—A decumbent or erect and more or less branching, leafy perennial 1.5-6 dm (½°-2°) high, with long, creeping rootstocks and densely flowered, spike-like panicles 3-6 cm. (1¼'-2¼') long. Spikelets 2-3 mm. (1"-1¼") long; empty glumes (*a*) acute, glabrous; flowering glume (*b*) glabrous, slightly shorter than the second glume and about equaling the obtuse palea.—Sandy shores, Virginia to Florida, westward to Texas. (Mexico and West Indies.) August to September.

FIG. 471. **BLEPHARONEURON TRICHOLEPIS** (Torr.) Nash, Bul. Torr. Bot. Club, **25**: 88. 1898. (*Vilfa tricholepis* Torr. Pac. R. R. Rept. **4**[5]: 155. 1857.)—A slender, erect, densely cæspitose perennial 3–6 dm. (1°–2°) high, with narrow, glabrous leaves and more or less spreading panicles 6–18 cm. (2⅓′–7′) long. Spikelets 2.5–3 mm. (1¼″–1⅓″) long; empty glumes (*a*) thin, smooth, carinate, 1-nerved; flowering glume (*b*) pubescent or villous on the 3 nerves. Palea nearly equaling the glume, slightly ciliate above and pubescent on the 2 nerves or nearly smooth.—Dry soil, Utah, Colorado to Texas, and westward to Arizona. (Mexico.) July to September.

FIG. 472. **POLYPOGON LITTORALIS** (With.) Smith Comp. Fl. Brit. ed. 2, 13. 1816. (*Agrostis littoralis* With. Bot. Arr. Brit. Pl. ed. 3, 2: *t. 25.* 1796. BEARD GRASS.—A tufted, slender, or rather stout perennial 3-6 dm. (1°-2°) high, with scabrous, flat leaves and narrow, densely flowered, many-lobed panicles 5-12 cm. (2′-5′) long. Spikelets 2-3 mm. (1″-1¼″) long; empty glumes (*a*) scabrous, more or less pubescent, tapering into an awn of about their own length; flowering glume (*b*) broadly truncate or emarginate; awn about 2 mm. (1″) long.—Wet places, California and Oregon to Vancouver Island. (Europe and South America.) May, June.

FIG. 473. **POLYPOGON MARITIMUS** Willd. Gesell. Nat. Fr. Neue Schrift. 3: 443. 1801. (*Phleum crinitum* Roxb.) SEASIDE BEARD-GRASS.—An erect, slender annual 1.5–3 dm. ($\frac{1}{2}°$–1°) high, with short, flat leaves and densely flowered, spike-like panicles 2–4 cm. ($\frac{3}{4}'$–$1\frac{1}{2}'$) long. Spikelets with two-lobed, awned empty glumes (*a*), which are villous at the apex and twice longer than the short-awned floral glume (*b*). Awn of the empty glumes 4–6 mm. (2″–3″) long.—Lower California. (Europe.) June

Fig. 474. **ARCTAGROSTIS LATIFOLIA** (R. Br.) Griseb. in Ledeb. Fl. Ross. 4: 434. 1853. (*Colpodium latifolium* R. Br. Suppl. App. Parry's Voy. 286. 1824. BROAD-LEAFED ARCTIC BENT.—A rather stout, glabrous, erect perennial 1.5–6 dm. (½°-2°) high, with narrow panicles 3-16 cm. (1¼′-6′) long. Sheaths shorter than the internodes; ligule 4 mm. (2″) long, truncate; leaf-blades 2-18 cm (1′-7′) long, 2-8 mm. (1″–4″) wide, scabrous. Spikelets 3-4 mm. (1½″-2″) long; empty glumes (*a*) unequal, the first about three fourths as long as the second, which is shorter than the obtuse, scabrous, flowering glume and palea (*b*). Greenland and Labrador to Alaska. (Northern Europe and Asia.) August.

FIG. 475. **ARCTAGROSTIS ARUNDINACEA** (Trin.) Beal, Grasses N. A. **2**: 317. 1896. (*Vilfa arundinacea* Trin. Unifl. 157. 1824; *Sporobolus arundinaceus* Vasey; *Colpodium arundinaceum* Hook.) **REED BENT.—A stout perennial 6–12 dm.** (2°–4°) high, with flat leaves and open panicles 20–35 cm. (8′–14′) long. Sheaths shorter than the internodes; ligule lacerate, 3–7 mm. (1½″–3½″) long; leaf-blades about 25 cm. (10′) long, 10 mm. (5″) broad. Spikelets compressed, with nearly equal empty glumes (*a*) about 4.5 mm. (2¼″) long; flowering glume (*b*) acute or obtuse, 3- to 5- nerved. Palea obtuse or bidentate, 2-nerved.—In wet soil, river banks, etc., Alaska and British America. (Northeastern Asia.) July, August.

Fig. 476. **CINNA BOLANDERI** Scribn. Proc. Acad. Nat. Sci. Phila. 1884: 290. 1884. CALIFORNIAN REED-GRASS.—A stout, leafy, erect perennial 15–22 dm. (5°–7°) high, with loose, open panicles 25–36 cm. (10′–14′) long. Leaf blades firm, prominently striate and scabrous on both sides, 30–60 cm. (12′–24′) long, 20 mm. (10″) wide, tapering to a sharp point. Spikelets about 5 mm. ($2\frac{1}{4}$″) long, with scabrous, broadly lanceolate, nearly equal empty glumes (*a*), which are a little longer than the 3-nerved nearly sessile floret (*b*).—California. No. 6090 Bolander. August.

Fig. 477. **CINNA LATIFOLIA** (Trev.) Griseb. in Ledeb. Fl. Ross. **4**: 435. 1853. (*Agrostis latifolia* Treviran, Beschreib. Bot. Gart. Breslau, 82. 1830; *Cinna pendula* Trin. 1841.) SLENDER INDIAN REED.—A rather slender, smooth perennial 6–12 dm. (2°–4°) high, with erect, simple culms, long, flat leaves 4–12 mm. (2″–6″) wide, and open, nodding panicles 10–20 cm. (4′–8′) long. Spikelets (*a*) about 3 mm. (1¼″) long, with nearly equal, acute outer glumes and short-awned or nearly awnless flowering glume (*b*), which is raised on a short stipe.—Thickets and moist woodlands, Newfoundland to British Columbia and southward to North Carolina and Utah. July to September.

Var. GLOMERATA Scribn. Proc. Acad. Nat. Sci. Phila. **1884**: 290. 1884. from British Columbia and Washington has the spikelets in dense clusters or glomerules at the extremities of the branches of the very diffuse panicle.

FIG. 478. **AGROSTIS PERENNANS** (Walt.) Tuckerm. Am. Journ. Sci. **45**: 44. 1843. (*Cornucopiæ perennans* Walt. Fl. Car. 74. 1788.) PERENNIAL BENT or THIN GRASS.—A slender, sparingly branched, leafy perennial, with weak, ascending culms 3–7.5 dm. (1°–2½°) long, and diffuse, capillary panicles 8–16 cm. (3′–6′) long. Sheaths smooth, shorter than the internodes; ligule about 2 mm. (1″) long; leaf-blades thin, flat, scabrous, about 10 cm. (4″) long, 2 mm. (1″) wide. Spikelets 1.5–2 mm. (⅔″–1″) long; empty glumes (*a*) slightly unequal, lanceolate, very acute, minutely scabrous on the keels; flowering glume is slightly shorter than the empty ones.—Damp, shaded places, Maine to Minnesota and Nebraska, southward to South Carolina and Mississippi. May to September.

Fig. 479. **AGROSTIS GEMINATA** Trin. Unifl. 207. 1824. MOUNTAIN BENT.—A slender, erect, densely cæspitose perennial 2–3.5 dm. (8′–14′) high, with short flat leaves, chiefly basal, and capillary, spreading panicles 5–8 cm. (2′–3′) long. Spikelets 2.5–3 mm. (1¼″–1½″) long; empty glumes (*a*) lanceolate, acute, the flowering glume (*b*) one-fourth shorter than the empty glumes, truncate or retuse, obscurely 5-nerved, about 1.7 mm. (⅘″) long, bearing an awn on the back which is shorter than or often exceeding the glume in length.—British Columbia to Alaska. August.

FIG. 480. **AGROSTIS RUBRA** Linn. Sp. Pl. 62. 1753. (*A. rupestris* Chapm. not All.) RED BENT.—A tufted, alpine perennial 1.5–4 dm. (6′–16′) high, with narrow, flat leaves, open, capillary panicles 5–10 cm. (2′–4′) long, and awned spikelets (*a*) 2.5–3 mm. ($1\frac{1}{4}''$–$1\frac{1}{2}''$) long; empty glumes subequal, smooth or hispid on the keel above, usually purple; flowering glume (*b*) slightly less than 2 mm. (1″) long, ovate, truncate; awn twice exceeding the glume, somewhat twisted and geniculate.—High mountains, Vermont and New Hampshire to North Carolina and Colorado, also in Labrador and Newfoundland. (Europe.) July, August.

FIG. 481. **AGROSTIS VARIABILIS** Rydb. Mem. N. Y. Bot. Garden **1**. 32. 1900 (*A. varians* Trin. Agrostidea **2**: 68. 1841; not Thuill. 1790.) SLENDER BENT-GRASS.—A densely caespitose perennial 1-2.5 dm. (4′-10′) high, with flat, erect leaves and contracted, almost spike like panicles 3-5 cm. (1¼′-2′) long. Sheaths mostly exceeding the **internodes; leaf-blades** 2-8 cm. (1′-3′) long, 1-2 mm. (½″-1″) wide. Spikelets 2.3 mm. (1¼″) long, with nearly equal, subacute empty glumes (*a*) and minutely toothed, hyaline, awnless flowering glume (*b*) 1.7 mm. (about ¾″) long. Palea minute or wanting.—Mountains of Oregon, Washington, and California. July to **September.**

FIG. 482. **AGROSTIS PALUDOSA** Scribn. U. S. Dept. Agr. Div. Agros. Bul. 11: 49, *f*. 7. 1898. MARSH BENT.—A low, densely cæspitose perennial 1–1.5 dm. (4′–6′) high, with soft, narrow leaves, and narrow, rather densely flowered panicles 3–5 cm. (1¼′–2′) long. Sheaths smooth, the lower ones thin and somewhat scarious; ligule elongated, about 2 mm. (1″) long; leaf-blades flaccid, at least the lower ones, minutely scabrous on both sides and on the margins, otherwise smooth. Spikelets about 3 mm. (1½″) long, with ovate-lanceolate, acute, empty glumes (*a*), which are a little longer than the broadly obtuse and minutely scabrous, awnless flowering glume (*b*). Palea 0.5 mm. (¼″) long.—Labrador. August, September.

FIG. 483. **AGROSTIS ALBA** Linn. Sp. Pl. 63. 1753. HERD'S GRASS or RED-TOP.—A well-known perennial of variable habit, often stoloniferous, with smooth culms 3–9 dm. (1°–3°) high, flat leaves and erect, many-flowered, open panicles 4–18 cm. (1½′–7′) long. Sheaths loose; ligule 2–8 mm. (1″–4″) long; leaf-blades 10–20 cm. (4′–8′) long, scabrous. Spikelets 2–3 mm. (1″–1¼″) long, with abruptly acute empty glumes (*a*), which are a little longer than the obtuse or truncate flowering glume (*b*). Palea one-half to three-fourths as long as the glume.—Throughout the United States, excepting in the extreme South. Europe.) June to September.

Var. VULGARIS (With.) Thurb. in A. Gray Man. ed. 6, 647. 1890, is a form with a short truncate ligule less than 2 mm. (1″) in length and more spreading panicle.

This exceedingly variable species is widely cultivated and is valuable for permanent meadows and pastures where the soil is not too dry. Some of the forms are excellent for lawns.

FIG. 484. **AGROSTIS VERTICILLATA** Vill. Prosp. 16. 1779. (*A. stolonifera* L.?) WATER BENT-GRASS.—A slender perennial, with flat leaves, erect or decumbent culms 2–6 dm. (8′–24′) long, and densely flowered, more or less interrupted panicles 5–25 cm. (2′–10′) long. Sheaths slightly shorter than the internodes, glabrous; ligule oblong, truncate; leaf-blades plane, spreading, scabrous above and on the margins. Spikelets about 1.5 mm. ($\frac{1}{16}$″) long, with nearly equal, minutely pubescent empty glumes (*a*) about one-half longer than the obtuse and minutely dentate awnless flowering glume (*b*).—Moist places, Utah to Texas and westward to California. (Mexico, South America, Europe, and India.) May to August.

FIG. 485. **CALAMAGROSTIS CINNOIDES** (Muhl.) Barton, Comp. Fl. Phila. 1: 45. 1818. (*Arundo cinnoides* Muhl. Gram. 187. 1817; *Calamagrostis nuttalli-*a Steud. Nom. ed. 2, 251. 1854.) **NUTTALL'S REED-GRASS.**—A stout, erect ...ennial 9–15 dm. (3°–5°) high, with rather broad, flat leaves and contracted ...nicles 6–14 cm. (2½′–5½′) long. Sheaths scabrous, sometimes slightly pubes...nt above, mostly shorter than the internodes; leaf-blades 2–3.5 dm. (8′–14′) ...g, 4–10 mm. (2″–5″) wide, pubescent or scabrous above, usually short-ciliate ...strongly scabrous beneath. Panicle glaucous-green and purple. Spikelets ...7 mm. (2½″–3½″) long; empty glumes (*a*) attenuate from near the base to the ...aceous, spreading tip, scabrous; flowering glume (*b*) 4–5 mm. (2″–2½″) long, ...d at the apex, copiously hairy at the base; awn attached about one-fourth ...m the apex, equaling or slightly exceeding the glume, straight, or nearly so. ...olongation of the rachilla (*c*) about 2 mm. (1″) long, its hairs equaling the ...lea.—Bogs and moist soil, Maine to Ohio, south to North Carolina and Alabama. August, September.

This differs from all other North American species of *Calamagrostis* in its hairy caryopsis and in having the prolongation of the rachilla villous only near the apex.

FIG. 486. **CALAMAGROSTIS BREWERI** Thurb. in S. Wats. Bot. Cal. 2: 280. 1880. BREWER'S REED-GRASS.—A slender, densely tufted perennial 1.5–3.5 dm. (6′–14′) high, with numerous setaceously-involute basal leaves, short culm-leaves, and open, few-flowered panicles 1.5–6 cm. (½′–2½′) long. Sheaths much shorter than the internodes; basal leaves 3–8 cm. (1¼′–3′) long, 1 mm. (1/24′) wide or less, minutely scabrous. Panicle ovate in outline, dark purple. Spikelets 3.5–4 mm. (1¾″–2″) long; empty glumes (*a*) nearly equal, acute; flowering glume (*b*) about 3 mm. (1½″) long, glabrous, or nearly so, the conspicuous nerves extending into very short, unequal, awnlike teeth; awn attached about one-fifth above the base, 4–5 mm. (2″–2¼″) long, bent near the middle. Callus hairs few, short. Prolongation of the rachilla (*c*) about 1.5 mm. (¾″) long, its hairs nearly as long as the palea.—Mountains of California. July, August.

This species has much the aspect of *Festuca ovina* L., and is distinguished from all other North American species of *Calamagrostis* by its strictly intravaginal innovations.

FIG. 487. **CALAMAGROSTIS INEXPANSA** A. Gray in Torr. Fl. N. Y. **2**: 445. pl. 152. 1843. (*C. confinis* A. Gray, Man. Bot. ed. 2. 547. 1856. Not Nutt. 1818.) BOG REED-GRASS.—A slender, erect perennial 7.5–12 dm. (2½°–4°) high, with narrow, flat leaves and **contracted panicles 15–20 cm. (6′–8′) long. Sheaths** shorter than the internodes, glabrous; leaf-blades 1.5–4.5 dm. (6′–18′) long, 2.5–5 mm. (1¼″–2½″) wide, scabrous on the margins and nerves, often pubescent above. Panicle erect, pale green, becoming brown and somewhat purplish. Spikelets 4–5 mm. (2″–2½″) long; empty glumes (*a*) lanceolate, strongly scabrous; flowering glume (*b*) 3–4 mm. (1½″–2″) long, minutely 4-dentate at the apex; awn attached about one-third above the base, erect, about equaling the glume. Callus hairs copious, nearly as long as the glume, **those of the rachilla** (*c*) equaling the glume.—Damp, sandy soil, New York and **New Jersey, westward** to South Dakota and Colorado.

Var. CUPREA Kearney, U. S. Dept. Agr. Div. **Agros. Bul. 11: 37. 1898.—A** stouter, more rigid form with more densely flowered **panicles, smaller and** copper-colored or purplish spikelets.—Washington.

Var. BARBULATA Kearney, l. c. Culms stout, pubescent below the constricted nodes, with short, reflexed hairs; panicle rigid, purplish; awn very short or wanting.—Washington.

FIG. 488. **CALAMAGROSTIS PORTERI** A. Gray, Proc. Am. Acad. 6: 79. 1862. PORTER'S REED BENT.—A slender, erect, glabrous perennial 6–12 dm. (2°–4°) high, with rough, flat leaves and narrow, rather loosely flowered panicles 8–16 cm. (3′–6′) long. Sheaths shorter than the internodes, rather loose, strongly bearded at the summit, otherwise smooth; leaf-blades 8–24 cm. (3′–10′) long, 2–7 mm. (1″–3½″) wide, attenuate to the filiform apex. Panicle pale brown, interrupted, erect. Spikelets 4–6 mm. (2″–3″) long; empty glumes (*a*) acute, thin but firm, minutely scabrous, the first slightly longer than the second; flowering glume (*b*) 4–5 mm. (2″–2½″) long, about equaling the second empty glume, narrowly truncate, minutely denticulate or sharply 4-dentate at the apex; awn attached about one-fifth above the base, 3–4 mm. (1½″–2″) long, stout, minutely scabrous, bent above the middle, twisted below the geniculation; basal hairs very few, one-third to two-fifths as long as the glume. Prolongation of the rachilla (*c*) about 1 mm. (½″) long, with its hairs about one-fifth shorter than the palea.—Dry woodlands, New York and Pennsylvania. July, August.

Fig. 489. **CALAMAGROSTIS SCOPULORUM** Jones, Proc. Calif. Acad. Sci. II. 5: 722. 1895. BROOM REED-GRASS.—A slender, erect, glaucous perennial, dm. (1⅛°–2⅔°) high, with elongated, lax, flat leaves and narrow, rather flowered panicles, 8–15 cm. (3′–6′) long. Sheaths shorter than the inter-, scabrous or glabrous, the lower ones marcescent; leaf-blades 15–50 cm. long, 2–6 mm. (1″–3″) wide, attenuate-acuminate, somewhat scabrous the margins and nerves. Panicle strict or somewhat flexuous, pale or dull . Spikelets 4–6 mm. (2″–3″) long; empty glumes (*a*) nearly equal, lan-, acuminate, scabrous on the keel, otherwise smooth; flowering glume 4 mm. (2″) long, narrowly truncate, and distinctly 4-dentate at the apex; attached near the middle, 1–2 mm. (½″–1″) long, straight, not equaling the . Palea about equaling the glume, 2-toothed, minutely scabrous on the . Callus hairs few, rather stiff. The prolongation of the rachilla is shown .—Wahsatch Mountains, Utah. September.

Var. LUCIDULA Kearney, U. S. Dept. Agr. Div. Agros. Bul. 11: 33. 1898.—A , pale, but not glaucous form, with short, firm leaves, more strict, , or lead-colored, somewhat shining panicles, and more compressed spikelets.—Utah.

FIG. 490. **CALAMAGROSTIS VASEYI** Beal, Grasses N. A. **2**: 344. 1896. (*C. purpurascens* of Vasey, Contr. U. S. Nat. Herb. **3**: 82. 1892. Not R. Br. 1823.) VASEY'S REED-GRASS.—A densely cæspitose, erect perennial, 6–7.5 dm. (2°–2½°) high, with flat, rather rigid leaves and contracted, spike-like, often interrupted panicles 6–12 cm. (2⅓′–5′) long. Sheaths much shorter than the internodes, minutely scabrous; leaf-blades 3–25 cm. (1′–10′) long, 2–3 mm. (1″–1⅓″) wide, attenuate, scabrous above and on the margins. Panicle pale green, becoming straw-colored and tinged with purple. Spikelets 6–7 mm. (3″–3⅓″) long: empty glumes (*a*) lanceolate; flowering glume (*b*) 4–6 mm. (2″–3″) long, truncate, the nerves extending as slender awns 1 mm. (⅙″) or less in length; awn attached near the middle of the glume, 10–12 mm, (5″–6″) long, sharply geniculate near the middle. Palea about equaling the glume, hyaline. Callus hairs few, very unequal, the longer ones equaling the flowering glume. Prolongation of the rachilla (*c*) with its longer hairs nearly or quite as long as the palea.—Mountains of Washington and Oregon. July, August.

This species is intermediate between *C. purpurascens* and *C. howellii.*

FIG. 491. **CALAMAGROSTIS PURPURASCENS** R. Br. in Rich. App. Frankl. ...rn. 731. 1823. PURPLE REED-BENT.—A rather rigid, densely cæspitose, ...t perennial 3–6 dm. (1°–2°) high, with firm, strongly involute leaves and ...sely flowered purple spike-like panicles 3–15 cm. (1¼′–6′) long. Sheaths ...se, the lower ones marcescent, scabrous, somewhat pubescent above; leaf-...ades 2–5 mm. (1″–2½″) wide, those of the innovations often 30 cm. (12′) long, ...e others shorter, scabrous beneath, densely short-pubescent above. Spikelets 4–8 mm. (2″–4″) long; empty glumes (*a*) lanceolate, attenuate-pointed, strongly ...abrous; flowering glume (*b*) 4–5 mm. (2″–2½″) long, truncate, the nerves extend-...g as short awn-like teeth, scabrous; awn attached near the base 4–8 mm. (2″–4″) ...g, minutely scabrous, sharply geniculate near the middle. Palea about as ...g as the glume, rather deeply bifid. Callus hairs few, short. Rachilla (*c*) ...spicuous, often 2 mm. (1″) long.—Dry, rocky soil in the mountains, Green-...and to Alaska, south in the mountains to South Dakota, Colorado, and Cali-...nia. July, August.

Var. ARCTICA Kearney, U. S. Dept. Agr. Div. Agros. Bul. 11: 19. 1898. A ...pauperate glabrous form 18 cm. (7′) high or less with short and comparatively ...oad leaf-blades and small panicles. Spikelets 5 mm. (2½″) long.—St. Paul ...land, Bering Sea. July.

FIG. 492. **CALAMAGROSTIS MACOUNIANA** Vasey, Contr. U. S. Nat. Herb. **3**: 81. 1892. (*Deyeuxia macouniana* Vasey, Bot. Gaz. **10**: 297. 1885.) MACOUN'S REED-BENT.—A slender, erect, leafy perennial, 4.5–9 dm. ($1\frac{1}{2}°$–$3°$) high, with narrow, flat leaves, and narrow, or (in anthesis) open, lanceolate panicles cm. (3′–6′) long. Sheaths close, the upper ones shorter than the internodes leaf-blades 6–20 cm. ($2\frac{1}{2}$′–8′) long, 2–5 mm. (1″–$2\frac{1}{2}$″) wide, attenuate, scabrous Panicle erect, densely flowered, pale purple. Spikelets 2–2.5 mm. (1″–$1\frac{1}{4}$″) long empty glumes (*a*) ovate-lanceolate, acute or acuminate, minutely scabrous least on the keel; flowering glume (*b*) about equaling the second empty glume thin-membranceous, with hyaline margins and apex: awn attached slightly above the middle, straight, equaling or slightly exceeding the glume Palea about three-fifths as long as the glume, hyaline, glabrous. Callus nent, its hairs copious, soft, about equaling the glume. Prolongation of the rachilla (*c*) very short and slender.—Moist sandy soil, borders of marshes Assiniboia to Missouri, Montana and Washington. May to August.

This species is distinguished from *C. canadensis*, to which it is most closely allied, by its usually stricter habit, smaller, more contracted, and denser panicles, and smaller spikelets.

Fig. 493. **CALAMAGROSTIS FASCICULATA** Kearney, U. S. Dept. Agr. Div. Agros. Bul. 11: 23. *f. 1.* 1898. COUCH REED-GRASS.—A slender, rather rigid, erect perennial 6–9 dm. (2°–3°) high, from creeping rootstocks, with narrow, mostly erect leaves, and contracted panicles 5–10 cm. (2′–4′) long. Sheaths shorter than the internodes; leaf-blades 5–20 cm. (2′–8′) long, 2–3 mm. (1″–1½″) wide, strongly involute, scabrous. Panicle interrupted, brown or purplish. Spikelets about 4 mm. (2″) long; empty glumes (*a*) acute, scabrous; flowering glume (*b*) about 3 mm. (1½″) long, truncate, and minutely 4-dentate at the apex; awn attached about one-fourth above the base, usually exceeding the glume, twisted below the geniculation. Callus hairs few, much shorter than the glume. Prolongation of the rachilla (*c*) 1–1.5 mm. (½″–¾″) long.—Mendocino and Marin counties, California. July, August.

FIG. 494. **CALAMAGROSTIS LANGSDORFFII** Trin. Gram. Unifl. 224 *f. 10.* 1824. LANGSDORFF'S REED-GRASS.—A stout, erect perennial, 6-12 dm. (2°-4°) high, with long flat leaves and open, pyramidal panicles 4-12 cm. long. Sheaths shorter than the internodes; leaf-blades 10-40 cm. (4′-16′) long, 4-12 mm. (2″-6″) wide, scabrous, usually densely short-pubescent above. Spikelets 4-6 mm. (2″-3″) long; empty glumes (*a*) lanceolate, attenuate, strong scabrous to pubescent with short strigose hairs; flowering glume (*b*) 3-5 mm. (1½″-2½″) long, truncate, becoming bifid, 4-dentate at the apex; awn attached about one-third above the base, 3-4 mm. (1½″-2″) long, stout, erect, exceeding the glume. Callus hairs very copious, soft, the longer ones exceeding the glume. Prolongation of the rachilla (*c*) copiously bearded, its hairs equaling those of the callus.—Moist meadows, etc., Newfoundland to Alaska, southw. to the mountains of New England, Colorado, Utah, and northern Californ. June to September.

Var. LACTEA (Beal) Kearney, U. S. Dept. Agr. Div. Agros. Bul. 11: 28. 18 (*C. lactea* Beal. 1896.) A form with whitish or pale green, more open panicles its palea more than two-thirds as long as the glume.—Washington.

FIG. 495. **CALAMOVILFA CURTISSII** (Vasey) Scribn. U. S. Dept. Agr. Div. Agros. Bul. **17**: 199, *f. 495.* 1899. (*Calamagrostis curtissii* Vasey, Contr. U. S. Nat. Herb. **3**: 85. 1892: *Ammophila curtissii* Vasey, Bul. Torr. Bot. Club, 11: 7. 1884.) SOUTHERN REED-GRASS.—A rather slender, wiry, erect perennial 9–18 dm. (3°–6°) high, from a stout rhizome, with narrow, involute leaves and contracted panicles 16–20 cm. (6′–8′) long. **Basal sheaths rigid, imbricate,** and distichous: ligule an obscure ciliate ring. **Spikelets about** 5 mm. (2¼″) long, with unequal empty glumes (*a*) and more or less hairy flowering glume and palea (*b*). **Callus bearded with a few short hairs.—Low pine barrens, Florida. July, August.**

FIG. 496. **TRISETUM MUTICUM** (Boland.) Scribn. U. S. Dept. Agr. Div. Agros. Bul. **11**: 50, *f. 10.* July, 1898. (*Trisetum subspicatum* var. *muticum* Boland. in S. Wats. Bot. Calif. **2**: 296. 1880; *Trisetum wolfii* Vasey, in part.) BEARDLESS FALSE OAT.—A rather stout or more often slender, erect, caespitose perennial 3–7.5 dm. (1°–2½°) high, with flat, glabrous, sometimes pilose leaves, and narrow or densely flowered panicles 8–18 cm. (3′–7′) long. Spikelets lanceolate 6–7 mm. (3″–3½″) long, 3 flowered; empty glumes acute, subequal, nearly as long as the spikelet; flowering glumes acute, nearly glabrous, very short-awned or awnless.—Dry situations, Montana to British America and southward to California, Wyoming, and Colorado. July to September.

This species is in every way stouter than *T. wolfii* (*fig. 497*) with broader, longer leaves and larger and more densely flowered panicles. The outer glumes are more nearly equal and the flowering glumes firmer in texture with rougher surface. *T. brandegei* Scribn., is a robust form of this species.

FIG. 497. **TRISETUM WOLFII** Vasey, in U. S. Geog. Surv. W. 100th Merid. **6**: 294, *t. 27.* 1898. Scribn. U. S. Dept, Agr. Div. Agros. Bul. **11**: 50, *f. 9.* 1898. WOLF'S FALSE OAT.—A slender, erect, tufted perennial, with rather short, flat, seabrous leaves and loosely-flowered, nodding and contracted panicles 5–10 cm. (2′–4′) long. **Spikelets** 2-flowered, 5–6 mm. (2½″–3″) long; empty glumes (*a*) nearly equal, about 6 mm. (3″) long; flowering glumes (*b*, *c*), obscurely 5-nerved, punctate-scabrous, bearing an awn often 1 mm. (½″) long. **Palea** (*d*) shorter than the glume.—Mountains of Colorado, rare.! August.

FIG. 498. **TRISETUM SHEARII** Scribn. U. S. Dept. Agr. Div. Agros. Cir. **29**: 8. 1901. (*T. argenteum* Scribn. U. S. Dept. Agr. Div. Agros. Bul. **11** : 49. *f. 8.* July, 1898. Not R. & S. 1817.) SILVER OAT-GRASS.—A slender, erect perennial, with smooth culms 5–7.5 dm. ($1\frac{2}{3}$°–$2\frac{1}{2}$°) high, minutely scabrous sheaths and leaves, and narrow, silvery-gray or purplish panicles 10–20 cm. (4′–8′) long. Spikelets 4–5 mm. (2″–$2\frac{1}{2}$″) long, 1- to 2- flowered, with unequal, acute empty glumes (*a*), and minutely scabrous, short-awned flowering glumes (*b*), the first one of which is about 4 mm. (2″) long, narrowly lanceolate, acute or slightly 2-cleft at the apex, awned below the apex; awn straight, 1–3 mm. ($\frac{1}{2}$″–$1\frac{1}{2}$″) long.—Near Silverton and Twin Lakes, Colorado. August.

Named for the collector, Mr. C. L. Shear.

FIG. 499. **AVENA FATUA** Linn. Sp. Pl. 80. 1753. WILD OAT.—An erect. glabrous annual 6–12 dm. (2°–4°) high, with flat leaves and spreading panicles of large oat-like, nodding spikelets. Sheaths smooth, or scabrous at the summit, sometimes sparingly hirsute; ligule 2–4 mm. (1″–2″) long. Spikelets 2- to 4-flowered; empty glumes (*a*) 18–24 mm. (9″–12″) long, smooth, inclosing the pubescent flowering glumes (*b*), which are 12–18 mm. (6″–9″) long; awns nearly twice as long as the spikelets, scabrous, twisted, and geniculate.—Fields and waste places from Minnesota westward; abundant in grain fields on the Pacific slope. **(Introduced from Europe.) June to September.**

FIG. 500. **BOUTELOUA POLYSTACHYA** (Benth.) Torr. in Pac. R. R. Rept. 5[2]: 366, *pl. 10.* 1857. (*Chondrosium polystachyum* Benth. Bot. Voy. Sulph. 56. 1844.) SIX-WEEKS GRAMA.—A slender and diffusely spreading, much-branched annual, 1–4 dm. (4′–16′) high, with short, narrow leaves, and 3 to 6 linear spikes about 2 cm. (¾′) long, approximate near the apex of the culm or its branches. Spikelets with glabrous, unequal empty glumes (*a*), the larger second one 1.5 mm. (⅓″) long, and 4-lobed flowering glumes (*b*), which are awned between the lobes and ciliate on the nerves. The 3-awned rudiment is shown by *d* and the palea by *c*.—River valleys, etc., Utah to Texas and westward to southern California. (Mexico.) July to September.

FIG. 501. **BOUTELOUA PROSTRATA** Lag. Varied. Cienc. Lit. Art. **2**: 141. 1805. TUFTED GRAMA.—A slender, tufted annual 1–2 dm. (4′–8′) high, with short, narrow leaves and solitary, curved, terminal spikes 1.5–2 cm. (½′–¾′) long. Sheaths loose, shorter than the internodes; ligule short; leaf-blades narrow, 1–4 cm. (½′–1½′) long. Spikelets with very unequal, glabrous, empty glumes (*a*), the second about 4 mm. (2″) long; flowering glume (*b*) broadly oblong, 3-lobed, 3-awned, smooth, or slightly pubescent on the back, about 6 mm. (3″) long. Rudiment reduced to 3 stiff awns with 1 or 2 scales at the base.—Common on bottom lands, New Mexico, Colorado, and Arizona. (Mexico.) June to October.

FIG. 502. **BOUTELOUA BROMOIDES** (H. B. K.) Lag. Gen. et Sp. Pl. 5. 1816. *Dinebra bromoides* H. B. K. Nov. Gen. et Sp. Pl. **1**: 172, *t. 51*. 1815.) SPRUCE-TOP.—A rather stout, erect perennial 3–6 dm. (1°–2°) high, with flat leaves and 5 to 7, more or less spreading spikes, racemose along the upper portion of the culm. Sheaths much shorter than the internodes; ligule a ciliate ring; leaf-blades sparsely hairy 4–12 cm. (1½′–5′) long, 2–3 mm. (1″–1¼″) wide. Spikelets 5 to 11 in each spike; empty glumes (*a*) ovate-lanceolate, 1-nerved, ciliate on the back, the first 3.5–4 mm. (1¾″–2″) long, the second longer; flowering glume (*b*) 5–6 mm. (2½″–3″) long, with 3 short awns; imperfect floret (*c*) raised on a short stipe, and with 3 long awns and a palea.—New Mexico and Arizona. (Mexico.) August to September.

FIG. 503. **ORCUTTIA GREENII** Vasey, Bot. Gaz. **16**: 146. 1891. CHICO GRASS.—A rigid, cæspitose, and more or less branching, leafy annual 1–2.5 dm. (4′–10′) high, with narrow and rather densely flowered spikes 2–6 cm. (¾′–2¼′) long. Sheaths loose, striate, pubescent or somewhat glabrous, shorter than the internodes; ligule obsolete; leaf-blades rigid, loosely involute, scabrous, 5 cm. (2′) long or less. Spikelets (*a*) compressed, 8–12 mm. (4″–6″) long, 9- to 15-flowered, with many-nerved, papillate-pilose and dentate glumes; empty glumes about 4 mm. (2″) long, prominently 9- to 11-nerved; flowering glumes (*b*) 5 mm. (2¼″) long with 5 to 7 prominent nerves terminating in as many teeth.—Habitat not known. **Chico, California, June.**

FIG. 504. **BLEPHARIDACHNE KINGII** (S. Wats.) Hack. in DC. Monog. Phan. **6** : 261. 1889. (*Eremochloë kingii* S. Wats. in King's Explor. 40th Par. 5: 382, *t. 40.* 1871.) KING'S DESERT-GRASS.—A low, densely tufted perennial 0.2–0.6 dm. (¾′–2½′) high, with numerous short, spreading recurved leaves 1–2 cm. (5″–10″) long, and densely flowered, subcapitate panicles partly inclosed in the upper leaf-sheaths. Spikelets about 3-flowered, with lanceolate, acute empty glumes (*a*) 6–7 mm. (3″–3⅓″) long; flowering glume (*b*) about 4 mm. (2″) long, deeply 2-cleft, densely hairy or villous at the base and along the keel and marginal nerves, the nerves extending into short awns, the middle one longest, shown in (*c*), and like the marginal ones ciliate.—Dry foothills in the deserts of Nevada and Arizona. April to July.

FIG. 505. **TRIODIA MUTICA** (Torr.) Scribn. Bul. Torr. Bot. Club **10**: 30. 1883. (*Tricuspis mutica* Torr. Pac. R. R. Rept. **4**[5]: 156. 1857.) SLENDER TRIODIA.—A slender, wiry, erect perennial 3–5 dm. (12′–20′) high, with short, narrow leaves and contracted panicles 10–20 cm. (4′–8′) long. Sheaths mostly exceeding the internodes; ligule ciliate; leaf-blades scabrous, involute, pungent-pointed. Spikelets 5 to 8 flowered, 8–10 mm. (4″–5″) long; empty glumes (*a*) 1-nerved, the first 5.5–6.5 mm. (2¾″–3¼″) long, the second about 1 mm. (½″) longer; flowering glumes (*b*, *c*) obtuse, emarginate 5.5–7 mm. (2¾″–3½″) long, pubescent on the keel and marginal nerves near the base.—Dry hillsides, Texas and Arizona. (Mexico.) April to October.

FIG. 506. **TRIODIA ELONGATA** (Buckl.) Scribn. new comb. (*Uni-*
elongata Buckl. Proc. Acad. Nat. Sci. Phila. **1862**: 89. 1862; *Tricuspis trine-*
glumus, Munro in A. Gray, l. c. 333, nomem nudum; *Triodia trinerviglumis* Vase-
Sieglingia elongata Nash.) WIRY TRIODIA.—A slender, erect, cæspitose pe-
nial 6–10 cm. (2°–3½°) high, with narrow leaves and contracted, spike-like pa-
cles 8–16 cm. (3′–6¼′) long. Spikelets 7- to 9- flowered, 6–10 mm. (3″–5″) lo-;
empty glumes subequal, the first lanceolate, obtuse or acute, scabrous, 3-nerv-
the second acute, carinate, hispid on the keel, 3- to 5- nerved; flowering glum-
(*b*) 4–5 mm. (2″–2½″) long and pubescent on the nerves below.—Dry soil, Miss-
to Arkansas and west to California and Arizona. June to September.

FIG. 507. **TRIODIA STRICTA** (Nutt.) Vasey, U. S. Dept. Agr. Div. Bot. Bul. **12**[2]: 38; *pl. 38.* 1891. (*Windsoria stricta* Nutt. Trans. Am. Phil. Soc. II. **5**: 147. 1833–1837.) SPIKED TRIODIA.—A stout, erect, cæspitose perennial 12–15 dm. (4°–5°) high, with rather long, rigid leaves, and densely flowered, spike-like panicles 10–30 cm. (4′–12′) long. Spikelets nearly sessile, 5 to 8-flowered, 4–5 mm. (2″–2½″) long, with lanceolate, acute, 1-nerved, empty glumes (*a*), which exceed the florets in length; flowering glumes (*c*) oblong, obtuse, 3-nerved, 2–3 mm. (1″–1¼″) long, and mucronate or short-awned. Lateral and dorsal nerves densely pilose, pubescent for three-fourths their length.—Moist soil, Louisiana and Mississippi to Kansas and Texas. August to October.

FIG. 508. **SIEGLINGIA DECUMBENS** (Linn.) Bernh. Syst. Verz. Pfl. Erfurt, 40. 1800. (*Festuca decumbens* Linn. Sp. Pl. 75. 1753; *Triodia decumbens* Beauv. Agrost. 67. 1812.) HEATHER-GRASS.—An erect or often decumbent. glabrous perennial 1.5–4.5 dm. (6′–18′) high, with narrow leaves and simple. contracted panicles 2–4 cm. (¾′–1½′) long. Sheaths shorter than the internodes. villous at the summit; leaf-blades smooth beneath, usually scabrous above. 2–15 cm. (1′–6′) long, 1–3 mm. (½″–1½″) wide. Spikelets (*a*) 3- to 5-flowered 6–10 mm. (3″–5″) long, with acute empty glumes which equal the spikelet in length. and obtusely 3-toothed flowering glumes (*b*, *c*) which are ciliate on the margins below; callus barbate.—Newfoundland. Introduced. (Europe, Asia.) August. September.

FIG. 509. **TRIPLASIS PURPUREA** (Walt.) Chapm. Fl. So. U. S. 560. 1860. (*Aira purpurea* Walt. Fl. Car. 78. 1788; *Tricuspis purpurea* A. Gray; *Sieglingia purpurea* Kuntze.) PURPLE SAND-GRASS.—A smooth, erect, or spreading, cæspitose perennial 3–9 dm. (1°–3°) high, with narrow, rigid leaves and simple panicles 2–6 cm. (¾′–2½′) long. Sheaths shorter than the internodes; leaf-blades 1–6 cm. (½′–2½′) long, 2 mm. (1″) wide or less, rigid scabrous, sometimes sparingly ciliate. Spikelets 2- to 5- flowered, 5–8 mm. (2½″–4″) long, with smooth empty glumes (*a*) and hairy, 2-lobed and short-awned flowering glumes (*d*). Palea, shown in (*c*), densely long-ciliate on the keels above.—**Sandy soil along the coast from Maine to Florida and westward to Nebraska and Texas. July to October.**

When fresh this grass has an acid taste.

FIG. 510. **MOLINIA CÆRULEA** (L.) Moench. Meth. 183. 1794. (*Aira cærulea* L. Sp. Pl. 63. 1753; *Enodium cæruleum* Gaud.) MOLINIA.—A rather coarse and rigid perennial 6–10 dm. (2°–3⅓°) high, with rather stiff leaves and narrow, usually purplish panicles 15–30 cm. (6′–12′) long. Sheaths overlapping and confined to the lower portion of the culm; leaf-blades smooth beneath, seabrous above. Spikelets 2- to 4-flowered, 5–8 mm. (2¼″–4″) long; empty glumes (*a*) oblong, unequal; flowering glumes (*b*) obtuse, 3-nerved, about 4 mm. (2″) long.—Sparingly introduced, in waste places, Maine, Vermont, and New York. (Europe.) August, September.

FIG. 511. **ERAGROSTIS MAJOR** Host, Gram. **4**: 14, *pl. 24.* 1809. (*Eragrostis poæoides megastachya* A. Gray.) CANDY-GRASS.—A rather showy, much-branched annual, with erect or ascending stems 1.5–9 dm. (½°–3°) high. Spikelets (*a*, *b*) 5- to 40- flowered, 5–16 mm. (2½″–8″) long, and about 3 mm. (1½″) wide; empty glumes nearly equal, ovate-lanceolate, 2 mm. (1″) or less in length; flowering glumes ovate, obtuse, prominently nerved and scabrous on the keel. A portion of the rachis of a spikelet with 1 palea and 2 florets attached is shown by *c*.—Naturalized in cultivated or waste ground, usually in sandy soil, throughout the United States. (Europe, Asia, naturalized in tropical America.) June to October.

When fresh this plant emits a strong, unpleasant odor.

FIG. 512. **ERAGROSTIS PILOSA** (Linn.) Beauv. Agrost. 162. 1812. (*Poa pilosa* L. Sp. Pl. 68. 1753.) SLENDER MEADOW-GRASS.—A slender, branching annual 1.5–4.5 dm. (6′–18′) high, with narrow, flat leaf-blades and open capillary panicles of small, appressed, 5- to 12- flowered spikelets (*a*) 3–6 mm. ($1\frac{1}{2}''$–$3''$) long: empty glumes ovate-lanceolate, obtuse, about 1 mm. ($\frac{1}{2}''$) long: flowering glumes (*c*) about 1.5 mm. ($\frac{3}{4}''$) long, with the lateral nerves very faint or obsolete. Palea (*d*) scabrous on the keels. The grain is shown by *e*, and the rachis of a spikelet by *b*.—In cultivated fields, roadsides, and sandy shores Massachusetts to Illinois and Kansas, south to Florida. Texas, and Arizona. (Widely distributed in tropical and warm temperate countries.) June to September.

This species is distinguished from *E. purshii* Scrhad., by the less spreading spikelets, which are much narrower in proportion to their length, and usually nerveless flowering glumes.

FIG. 513. **ERAGROSTIS TRICHODES** (Nutt.) Nash, Bul. Torr. Bot. Club, **22**: [illegible]. 1895. (*Poa trichodes* Nutt. Trans. Am. Phil. Soc. II, **5**: 146. 1833–1837; *Eragrostis tenuis* A. Gray, not Steud.) BRANCHING SPEAR-GRASS.—A tall perennial 6–15 dm. (2°–5°) high, with rather narrow, elongated, many-flowered panicles, and somewhat rigid leaves. Spikelets (*a*, *b*) 3- to 10- flowered, 5–10 mm. ([illegible]"–5") long; empty **glumes very acute, about equal**; flowering glumes acute, the lower ones 2.5–3 mm. (1¼"–1⅛") long, the lateral nerves prominent. The palea is shown by *c* and **the pistil by** *d*.—**Sand-hills and prairies, Illinois to** Nebraska, Louisiana, Indian Territory, and Texas. July to September. Of no agricultural value.

FIG. 514. **ERAGROSTIS CAPILLARIS** (Linn.) Nees, Agrost. Bras. 505. 1829. (*Poa capillaris* Linn. Sp. Pl. 68. 1753; *Poa tenuis* Ell. Sk. Bot. S. C. and Ga. 1: 156. 1817.) LACE-GRASS.—An erect annual 1.5–6 dm. ($\frac{1}{2}$°–2°) high, branching at the base, with oblong-ovoid, widely expanded capillary panicles of very small, 2- to 4- flowered spikelets (*a*) 2-3 mm. (1″–1½″) long; empty glumes about 1 mm. ($\frac{1}{2}$″) long, equal, acute, hispid on the keel; flowering glumes acute, obscurely 3-nerved, about 1.5 mm. ($\frac{3}{4}$″) long. Palea rough-ciliate on the keels.—Dry and sandy fields and roadsides, Rhode Island to Illinois and Missouri, southward to Georgia and Texas. August, September.

Of no agricultural interest.

FIG. 515. **ERAGROSTIS OBTUSIFLORA** Scribn. U. S. Dept. Agr. Div. Agros. Bul. **8**: 10. *pl. 5.* 1897. (*Brizopyrum obtusiflorum* Fourn. Mex. Pl. **2**: 120. 1881?.) MEXICAN SALT-GRASS.—A rigid, erect, branching perennial 3–5 dm. (1°–2⅔°) high, from strong, scaly rootstocks, with stiff, pungent-pointed leaves and more or less spreading panicles 8–14 cm. (3′–5½′) long. Spikelets 5- to 12-flowered, 7–15 mm. (3½″–7½″) long; empty glumes (*a*) somewhat compressed, 1-nerved; flowering glumes (*b*, *c*) obtuse or subacute, rounded on the back, smooth. Palea (*d*) broadly 2-keeled, minutely scabrous on the keels.—Sandy, alkaline soil, Arizona. August, September.

Resembles salt-grass (*Distichlis spicata*) in habit.

FIG. 516. **ERAGROSTIS SECUNDIFLORA** Presl, Rel. Haenk. 1: 276. 18 (*Eragrostis oxylepis* Torr. 1854; *Poa interrupta* Nutt., not Lam.) PURPLE LOVE-GRASS.—A smooth perennial 1.5–9 dm. (½°–3°) high, with rather rigid narrow leaves and contracted or open panicles 3–12 cm. (1¼′–5′) long. Spikelets (*a*, *b*) crowded, strongly compressed, 8- to 40- flowered, 6–20 mm. (3″–10″) long; empty glumes subequal, acute; flowering glumes (*c*) 3–3.5 mm. (1½″–1¾″) long, acute, usually purple-bordered, the lateral nerves prominent.—Dry soil. Florida, Alabama, and westward to Kansas, Indian Territory, Texas, and California. (Mexico and Central America.) July to November.

FIG. 517. **ANTHOCHLOA COLUSANA** (Davy) Scribn. U. S. Dept. Agr. Div. Agros. Bul. **17**: 221, *f. 517*. 1899. (*Stapfia colusana* Davy, Eryth. **6**: 110. 1898; *Neostapfia colusana* Davy, Eryth. **7**: 43. April, 1899; *Davyella colusana* Hack. May, 1899.)—A densely cæspitose, spreading or ascending, glabrous annual (?), with loose sheaths, rather short, flat leaves, and densely flowered, oblong or cylindrical, spike-like panicles 3–7 cm. ($1\frac{1}{4}'$–$2\frac{3}{4}'$) long. Spikelets (*a*, *a'*) usually 3- to 5- flowered, 6–7 mm. ($3''$–$3\frac{1}{2}''$) long, with very broad, flabelliform, ciliate-fringed, many-nerved flowering glumes (*c*) about 5 mm. ($2\frac{1}{2}''$) long. Lower empty glumes, when present, narrowly lanceolate. The palea is shown by *d* and the pistil by *e*.—Uncultivated alkali "goose lands," Colusa County, California.

The genus *Neostapfia* is recognized by Hackel in Engl. & Prantl, Nat. Pfl. **2**^{2}, Nachtr. II: 6. 1900.

FIG. 518. **MELICA IMPERFECTA** Trin. Gram. Suppl. 68. 1836. (*M.*
dioides Nees; *M. panicoides* Nutt.) SMALL-FLOWERED MELIC-GRASS
somewhat slender, erect perennial 6–9 dm. (2°–3°) high, with narrow, flat
and more or less diffusely spreading, many-flowered panicles. Sheaths ex
ing the internodes, striate; ligule 2–3 mm. (1‴–1½‴) long; leaf-blades
glabrous. Spikelets 1- to 2- flowered, 3–5 mm. (1½‴–2½‴) long, with the
glumes (*a*) shorter than the spikelet; rudimentary floret sessile or nearly
Hillsides and grassy mountain slopes, California. (Lower California.) Ma
to July.

Var. MINOR Scribn. Proc. Acad. Nat. Sci. Phila. **1885**: 42. Is characteriz
its low and densely tufted habit, short leaves, slender, few-flowered pani
and generally smaller spikelets.

FIG. 519. **MELICA TORREYANA** Scribn. Proc. Acad. Nat. Sci. Phila. **1885**: 47. 1885. TORREY'S MELIC-GRASS.—A slender, leafy, cæspitose perennial 6–9 dm. (2°–3°) high, with flat leaves and more or less spreading panicles 12–20 cm. (4½′–8′) long. Ligule 6–8 mm. (3″–4″) long, lacerate; leaf-blades numerous, 15–20 cm. (6′–8′) long, 4–6 mm. (2″–3″) wide. Spikelets usually 1-flowered, with the rudiment of a second flower raised upon a long pedicel; empty glumes (*a*) as long as or exceeding the flowering glume (*b*), which is minutely pubescent toward the apex.—California. May to September.

This species is distinguished from *Melica imperfecta*, with which it is very closely allied, by its more membranaceous, longer, and more acute outer glumes, long-pediceled rudimentary floret, and pubescent flowering glume.

FIG. 520. **MELICA FUGAX** Boland. Proc. Calif. Acad. Sci. **4**: 104. 1870. SMALL MELIC-GRASS.—A slender, erect perennial 1.5–3.5 dm. (6′–18′) high from a bulbous base, with flat leaves and few-flowered, narrow panicles 8–16 cm. ($3\frac{1}{4}$′–$6\frac{1}{2}$′) long. Spikelets 6–8 mm. (3″–4″) long, 3- to 5-flowered: empty glumes (*a*) obtuse, unequal, the first 1-nerved, the second obscurely 3- to 5-nerved, seabrous margined; flowering glumes (*b*) about 4 mm. (2″) long. Palea minutely pubescent on the arched keels, slightly shorter than the glume.—Low grounds in open pine woods, dry mountain sides, etc., Washington to California. May, June.

In the spikelets of *M. fugax* the rachilla is smooth, thickened, and of a peculiar spongy texture quite unlike that of any other American species.

FIG. 521. **MELICA LONGILIGULA** Scribn. & Kearney, U. S. Dept. Agr. Div. Agros. Bul. 17: 225. *f. 521.* 1899.—A slender, erect, caespitose perennial 6–7.5 dm. (2°–2½°) high, with narrow leaves, and strict, more or less interrupted panicles 15–20 cm. (6′–8′) long. Sheaths exceeding the internodes; ligule 5–6 mm. (2½″–3″) long, truncate, hyaline; leaf-blades 15–20 cm. (6′–8′) long, about 2 mm. (1″) wide, minutely scabrous above. Spikelets 3- to 5-flowered, 6–8 mm. (3″–4″) long, on short, pubescent pedicels; glumes obtuse, minutely scabrous, the outer ones (*a*) unequal, the larger second one 5–5.5 mm. (2½″–2¾″) long; the first flowering glume (*b*) 5–6 mm. (2½″–3″) long.—Southern California. (No. 865. Parish Brothers, 1881.)

Distinguished from *M. imperfecta*, with which it is closely related, by its larger and 2- to 3-flowered spikelets, lower empty glumes, and palea distinctly shorter than the flowering glumes.

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FIG. 522. **MELICA BULBOSA** Thurb. in S. Wats. Bot. Calif. **2**: 304. 18[illegible] Not Geyer (*Melica poaoides* Torr. in Pac. R. R. Rept. **4**[5]: 157. 1857. Not Nu[illegible] *Melica californica* Scribn. Proc. Acad. Nat. Sci. Phila. **1885**: 46. 1885). CALI-FORNIA MELIC-GRASS.—A slender, erect perennial, from a bulb-like b[illegible] 3–9 dm. (1°–3°) high, with very narrow leaves and contracted, densely flowe[red] panicles 8–16 cm. (3′–6′) long. Spikelets 8–10 mm. (4″–5″) long, usually wi[th] [illegible] perfect flowers (*b*), the rudimentary one obtuse; empty glumes (*a*) unequal, [illegible] second as long as the first flowering glume; flowering glumes obtuse, the [illegible] one about 8 mm. (4″) long.—Dry slopes and ridges, California. April to Ju[ne].

The first and second publications of *Melica bulbosa* Geyer, are *nomina* [illegible] The first publication of the name, with description, is by Thurber in the bota[ny] of California, and while the species there described is not the original plan[t] [illegible] Geyer at all, nevertheless the name must stand for the plant there describe[d].

FIG. 523. **MELICA FRUTESCENS** Scribn. Proc. Acad. Nat. Sci. Phila. **1885:** 45, *pl. 1, f. 15–16.* 1885. WOODY MELIC-GRASS.—A stout, leafy perennial 6–10 dm. (2°–3⅓°) high, somewhat woody at the base, with flat, scabrous leaves and rather densely flowered, strict panicles 10–30 cm. (4′–12′) long. Spikelets usually 5-flowered, about 12 mm. (6″) long; empty glumes (*a*) unequal, the second about 2 mm. (1″) longer than the first and nearly equaling the spikelet; flowering glumes (*b*) about 8 mm. (4″, long, obtuse, the papery-membraneous tip occupying fully one-third of its length. Palea usually about one-half as long as the glume.—Southern California. (Lower California, Mexico.) April to June.

FIG. 524. **MELICA INFLATA** Vasey, Contr. U. S. Nat. Herb. 1: 269. 1893.
INFLATED MELIC-GRASS.—An erect, leafy perennial 9–18 dm. (3°–6°) high, bulbous at the base, with spreading, simple panicles 12–20 cm. (5′–8′) long. Leaf-blades 15–25 cm. (6′–10′) long, 2–4 mm. (1″–2″) wide; ligule conspicuous. Spikelets (*a*) 12–18 mm. (6″–9″) long, 6- to 8-flowered; empty glumes oblong, subacute, the first 3- to 5-nerved, the second 5- to 7-nerved; flowering glumes (*b*) about 8 mm. (4″) long, subacute, scabrous, oblong-lanceolate. Palea (*c*) one-third shorter than the glume, somewhat scabrous, ciliate above.—Mountains of California. June, July.

Allied to *Melica bulbosa* Thurb. (Fig. 522.)

FIG. 525. **MELICA HARFORDII** Boland. Proc. Calif. Acad. Sci. **4**: 102. 1870.
HARFORD'S MELIC-GRASS.—A rather slender, erect, wiry perennial 6–15 dm. (2°–5°) high, with narrow, flat leaves and erect, narrow, light-green or straw-colored panicles 10–20 cm. (4′–8′) long. Spikelets 12–16 mm. (6″–8″) long, 4- to 8- flowered; empty glumes (*a*) unequal, the second one about 6 mm. (3″) long; flowering glumes (*b*) 8 mm. (4″) long, usually short-awned and ciliate with long, shining hairs for two-thirds of the margin below.—Mountains of California, Oregon, and Washington. June, July.

FIG. 526. **MELICA CEPACEA** (Phil.) n. comb. (*M. subulata* Scribn. Proc. Acad. Nat. Sci. Phila. **1885**: 47. *Festuca cepacea* Phil. Linnaea **33**: 297. 1864–65; *Melica acuminata* Boland. 1870.) SLENDER FLOWERED MELIC-GRASS.—An erect leafy perennial 9–12 dm. (3°–4°) high, from a bulbous base, with flat leaves and rather lax panicles 10–20 cm. (4′–8′) long. Spikelets 3- to 5-flowered, with unequal empty glumes (*a*) and long-attenuate-pointed flowering glumes (*b*) about 12 mm. (6″) long, ciliate on the margins and hirsute on the back below.—Shaded canyons and damp woodlands, British Columbia to California, east to Montana **(South America). May to September.**

FIG. 527. **MELICA SMITHII** (Porter) Vasey. Bul. Torr. Bot. Club, **15**: 294. 1888. (*Avena smithii* T. C. Porter in A. Gray, Man. Bot. ed. 5, 640. 1867.) **SMITH'S MELIC-GRASS.**—A slender, erect perennial 4.5–10 dm. ($3\frac{1}{6}$°–$3\frac{1}{3}$°) high, with flat leaves, and spreading panicles 12–24 cm. (5′–10′) long. Sheaths shorter than the internodes; ligule 4 mm. (2″) long; leaf-blades 10–20 cm. (4′–8′) long, 6–12 mm. (3″–6″) wide, seabrous. Spikelets (*a*) 3- to 6- flowered, 20 mm. (10″) long, with unequal empty glumes and awned, glabrous flowering glumes (*b*) about 10 mm. (5″) long; awn one-fourth to one-half as long as the glume. The palea is shown by *c*.—Moist woodlands to Michigan, Montana, Washington, and British Columbia. June to August.

Allied to *M. aristata* Thurb. (Fig. 528.)

FIG. 528. **MELICA ARISTATA** Thurb. in Boland. Proc. Calif. Acad. Sci. 4: 103. 1870. BEARDED MELIC-GRASS.—A slender, tufted perennial 4.5–10 dm. (1½°–3½°) high, with flat, usually pubescent leaves and narrow panicles 10–25 cm. (4′–10′) long. Sheaths as long as the internodes; ligule 4 mm. (2″) long, scabrous; leaf-blades flat, pubescent, about 10 cm. (4′) long, 3–4 mm. (1½″–2″) wide. Spikelets 3- to 5-flowered, with unequal empty glumes (*a*) and awned flowering glumes (*b*), which are 10–12 mm. (5″–6″) long, and have a few stiff marginal hairs near the base; awn 8–14 mm. (4″–7″) long.—Washington to California. June, July.

FIG. 529. **PLEUROPOGON CALIFORNICA** (Nees) Vasey, U. S. Dept. Agr. Div. Bot. Bul. **13**: 68, *pl. 68*. 1893. (*Lophochlaena californica* Nees, Ann. Nat. Hist. I., **1**: 283. 1838. Hook. & Arnot, Bot. Beechy Voy. 403, *t. 95*. 1841.) CALIFORNIA PLEUROPOGON.—A pale-green, tufted perennial, with soft or rather weak culms 3–6 dm. (1°–2°) high, flat leaves, and terminal racemes of 6 to 12 erect or spreading spikelets about 2 cm. (¾′) long; empty glumes (*a*) thin-membranaceous, smooth, 1-nerved below, the first 2–3 mm. (1″–1½″) long, the second 2 mm. (1″) longer; flowering glumes (*b*) scabrous, about 6 mm. (3″) long, erose or dentate at the obtuse, membranaceous apex, bearing a rough awn just below the apex which is about as long as the glume. The palea is shown by c.—Low, moist grounds, California. May.

FIG. 530. **UNIOLA LONGIFOLIA** Scribn. Bul. Torr. Bot. Club, **21**: 229. 1894. LONG-LEAFED SPIKE-GRASS.—A rather stout perennial 6–12 dm. (2°–4°) high, with long, flat leaves and narrow panicles 15–45 cm. (6′–18′) long. Sheaths somewat compressed, pubescent or lanate, at least the lower ones, with a dense ring of soft hairs at the apex; lower leaf-blades 30 cm. (12′) long or more, 8–16 mm. (4″–8″) wide, seabrous near the apex, often more or less pubescent at the base. Spikelets (*a*) 3- to 4-flowered, 7–8 mm. (3½″–4″) long, with 9- to 11-nerved flowering glumes (*c*) 3.5–5 mm. (1¾″–2½″) long.—In dry soil, low woods, and thickets, or in hummock land, East Tennessee to Florida, Texas, and Indian Territory.

FIG. 531. **UNIOLA SESSILIFLORA** Poir. in Lam. Encyc. **8**: 185. 1806. (*Uniola nitida* Baldw. in Ell. Sk. Bot. S. C. and Ga. **1**: 167. 1817.) SHORT-STALKED UNIOLA.—A rather slender, wiry perennial 3–9 dm. (1°–3°) high, with flat, spreading leaves and simple, rigid panicles 5–20 cm. (2′–8′) long. Ligule a fringe of hairs: leaf-blades flat, smooth, 15–20 cm. (6′–8′) long, 3–4 mm. (1½″–2″) wide. Spikelets (*a*) strongly flattened, 6- to 8- flowered, 12–16 mm. (6″–8″) long, with sharply acuminate-pointed empty glumes 6–8 mm. (3″–4″) long; flowering glumes (*b*) about 8 mm. (4″) long, acute, scabrous on the keels, about 13-nerved.—On hummocks in shady swamps near the coast, Georgia to Louisiana. June to October.

FIG. 532. **DISTICHLIS TEXANA** (Vasey) Scribn. U. S. Dept. Agr. Div. Agros. Bul. **17**: 236. *f.* 532. June 30, 1899. (*Poa texana* Vasey, Contr. U. S. Nat. Herb. 1: 60. 1890; *Sieglingia wrightii* Vasey, l. c. 269. 1893.)—A rather stout, rigid, glabrous, creeping or stoloniferous perennial 3–6 dm. (1°–2°) high, with flat leaves and densely flowered, narrow panicles 10–20 cm. (4′–8′) long. Staminate spikelets (*a*) compressed, 5- to 7- flowered, 10–12 mm. (5″–6″) long; empty glumes obtuse; flowering glumes (*b*) 3-nerved, 4–6 mm. (2″–3″) long; pistillate spikelets (*d*) subterete, fusiform, 12–25 mm. (6″–12½″) long; empty glumes (*c*) nearly equal: flowering glumes (*d*, *e*) 8–10 mm. (4″–5″) long, 3- to 5- nerved.—Western Texas. New Mexico. (Mexico.)

FIG. 533. **POA ANNUA** Linn. Sp. Pl. 68. 1753. LOW SPEAR-GRASS or SUMMER-GRASS.—A low, tufted annual, with erect or ascending, somewhat flattened culms 0.5–3 dm. (2′–12′) high, smooth, flat, spreading leaves, and short, pyramidal panicles. Sheaths smooth, lax; leaf-blades smooth, 2.5–8 cm. (1′–3′) long, 2–3 mm. (1″–1½″) wide. Spikelets (*a*) 3- to 6- flowered, about 4 mm. (2″) long; empty glumes slightly unequal, the first 1-nerved, the second 3-nerved; flowering glumes (*b*) obtuse, hairy on the nerves below and pilose at the base, about 2 mm. (1″) long, distinctly 5-nerved. Palea 2-keeled, keels hairy.—Fields and waste places, dooryards, etc., everywhere throughout the United States and British America. (Europe.) April to September.

FIG. 534. **POA BIGELOVII** Vasey & Scribn. Contr. U. S. Nat. Herb. 1: 5 1893. BIGELOW'S BLUE-GRASS.—A slender, smooth annual 1-6 dm. (4'-2°) high, with flat leaves and narrow panicles 4-12 cm. (1½'-5') long. Ligule thin, membranaceous, leaf blades 5-10 cm. (2'-4') long, 2-4 mm. (1"-2") wide. Spikelets (a) 4-6 mm. (2"-3") long, 3- to 5-flowered, with the acute empty glume nearly as long as the florets (b), which are 3-4 mm. (1½"-2") long, villous on the keel and the lower half of the marginal nerves, and with few long, cobwebby hairs at the base. Palea one third shorter than the glume.—Moist soil, Colorado southward to Texas, New Mexico, Arizona, and California. (Mexico.) April to July.

This species is distinguished from *P. annua* by its narrow, elongated panicles and by the presence of the cobwebby hairs at the base of the florets.

FIG. 535. **POA DEBILIS** Torr. Fl. N. Y. **2**: 459. 1843. SLENDER SPEAR-GRASS.—A slender, erect, smooth perennial 3-5 dm. (1°-2¼°) high, with rather short, flat leaves and nodding, few flowered, open panicles 4-12 cm. (1½'-5') long. Sheaths compressed, much shorter than the internodes; ligule 1-2 mm. (½''-1'') long; leaf blades 2.5-11 cm. (1'-4½') long, 2 mm. (1'') wide or less, smooth beneath, **scabrous above. Spikelets 3-4 mm. (1½''-2'') long, 2- to 4-**flowered, with unequal, acute empty glumes (*a*), broadly obtuse and scarious-tipped, 5-nerved flowering glumes (*b*), which are conspicuously webbed at the base, otherwise glabrous.—In rocky woodlands, Nova Scotia and New Brunswick southward to **Pennsylvania and westward to Minnesota. May to July.**

FIG. 536. **POA ALSODES** A. Gray, Man. Bot. ed. 2, 562. 1856. WOODLAND BLUE-GRASS. A slender, erect, smooth perennial 1.5–6 dm. (½°–2°) high, with flat leaves and open panicles 9–20 cm. (3½′–8′) long. Sheaths rather thin, the upper somewhat scabrous; ligule 1 mm. (½″) long or less; leaf-blades 12–30 cm. (5′–12′) long, 2–4 mm. (1″–2″) wide, scabrous, at least toward the acute apex. Spikelets (*a*) 5 mm. (2½″) long, 2- to 3-flowered; empty glumes acute, unequal, the first 1-nerved, the second 3-nerved; flowering glumes (*b*) acute, about 4 mm. (2″) long, narrowly ovate, very faintly nerved, villous on the keel below and with a tuft of long, cobwebby hairs at the base.—Thickets and open woodlands, Nova Scotia to Ontario and Minnesota, southward to North Carolina and Tennessee. May, June.

FIG. 537. **POA LEPTOCOMA** Bong. Vég. Ins. Sitch. 170. 1831. SLENDER MOUNTAIN BLUE-GRASS.—A slender, erect perennial, about 3 dm. (1°) high, with flat leaves and delicate, open panicles 4-8 cm. (1½′-3′) long. Leaf-blades narrow, 1-2 mm. (½″-1″) wide. Panicle spreading, 5-10 cm. (2′-4′) long, the few-flowered, filiform branches in pairs. Spikelets 2- to 3-flowered, about 6 mm. 3″ long, with slightly unequal empty glumes (b) and linear-lanceolate, acute flowering glumes (a), which are villous on the keel and marginal nerves below, and webbed at the base.—Wet, boggy places, mountains of Colorado, northward to Alaska. July, August.

FIG. 538. **POA REFLEXA** Vasey & Scribn. Contr. U. S. Nat. Herb. 1: [illegible] 1893. NODDING BLUE-GRASS.—A slender, erect perennial, with soft, [illegible] leaves, and open pyramidal panicles, with **capillary, rather distant, and [illegible] reflexed branches.** Spikelets (*a*) 3–4 mm. ($1\frac{1}{2}''$–$2''$) long, 2- to 3- flowered; empty glumes nearly equal, scabrous on the keels; flowering glumes (*b*) distinctly 5-nerved, 2.5–3.5 mm. ($1\frac{1}{4}''$–$1\frac{3}{4}''$) long, ovate-lanceolate, obtuse, pubescent on the middle and lateral nerves and webbed at the base. Palea one-fourth [illegible] than the glume, scabrous on the keels.—Wet, boggy places, mountains [illegible] Wyoming and Colorado to Washington and British America. July, August.

Closely related to *P. leptocoma* Trin., from which it differs in its more numerous spikelets, which are crowded at the ends of the branches, and especially **in the rounded, obtuse flowering glumes.**

FIG. 539. **POA TRIVIALIS** Linn. Sp. Pl. 67. 1753. ROUGH-STALKED MEADOW-GRASS.—An erect, usually slender perennial 3–9 dm. (1°–3°) high, with flat leaves and open, many-flowered panicles, 6–15 cm. (2½′–6′) long. Sheaths slightly scabrous; ligule 4–6 mm. (2″–3″) long; leaf-blades 7.5–15 cm. (3′–6′), long, about 4 mm. (2″) long. Culms usually rough near the panicle. Spikelets 2- to 3- flowered, about 3 mm. (1½″) long; empty glumes (*a*) very acute, the first 1-nerved, the second broader and 3-nerved; flowering glumes (*b*) strongly 5-nerved, silky-pubescent on the keel below and with long, cobwebby hairs at the base. Palea smooth.—Meadows and roadsides throughout the United States. (Europe.) May to August.

Related to *P. pratensis*, but differing from that species in the absence of any creeping rootstocks, longer ligule, and more strongly nerved flowering glume. *Poa trivialis* has been cultivated for many years in England and Europe and is valuable for the formation of permanent meadows.

FIG. 540. **POA OCCIDENTALIS** Vasey, Contr. U. S. Nat. Herb. **1**: 274. 1893. WESTERN BLUE-GRASS.—A slender or somewhat stout, leafy perennial 4.5–8 dm. ($1\frac{1}{2}$°–$2\frac{2}{3}$°) high, with open, loosely flowered panicles 15–30 cm. (6′–12′) long. Sheaths compressed, seabrous, mostly much longer than the internodes; ligule conspicuous, obtuse, seabrous on the outside; leaf-blades 5–15 cm. (2′–6′) long. Spikelets 4–6 mm. (2″–3″) long, mostly 3-flowered; empty glumes (*a*) acute, unequal; flowering glumes (*b*) obtuse, 3–4 mm. ($1\frac{1}{2}$″–2″) long, 5-nerved, slightly pubescent on the keel below, and with a distinct tuft of cobwebby hairs at the base.—In moist soil, New Mexico northward to Colorado and Wyoming; also (?)**Alaska. June to September.**

Fig. 541. **POA TRACYI** Vasey, Bul. Torr. Bot. Club, **15**: 49. 1888. TRACY'S BLUE-GRASS.—A rather stout, erect perennial, 4.5–10 dm. (1½°–3⅓°) high, with flat leaves and open panicles 15–25 cm. (6′–10′) long. Sheaths mostly shorter than the internodes, smooth, the lower ones rather loose; leaf-blades 10–20 cm. (4′–8′) long, 3–5 mm. (1½″–2½″) wide, those of the culm shorter. Spikelets clustered near the ends of the branches, 3- to 4- flowered, about 5 mm. (2½″) long: empty glumes (*a*) subequal, slightly scabrous on the keels; flowering glumes (*b*) nearly 4 mm. (2″) long, and white pubescent on the back below, ciliate-hairy on the marginal nerves and keel.—Moist soil, Colorado and New Mexico. June to August.

Distinguished from *P. occidentalis* Vasey, by the copious pubescence on the keel and marginal nerves.

FIG. 542. **POA ARACHNIFERA** Torr. in Marcy's Explor. Red Riv. **La.** 301. 1853. TEXAS BLUE-GRASS.—A hardy perennial 3–9 dm. (1°–3°) high, with strong, creeping rootstocks, long, flat leaves, and narrow, rather densely flowered panicles. Spikelets ovate-lanceolate, 3- to 7-flowered, 4–8 mm. (2″–4″) long; empty glumes (*a*, *c*) acute, the first 1-nerved, the second 3-nerved, scabrous on the keels; flowering glumes of the fertile spikelets (*b*) 5-nerved, hairy on the nerves and with a copious tuft of long cobwebby hairs at the base, those of the sterile or staminate spikelets (*d*) smooth.—A native of Texas, and introduced into cultivation in some of the Southern States. It forms a dense turf, and as it makes its chief growth in the winter months it is of especial importance in the South as a winter forage plant. It is hardy in the latitude of Washington, D.C. **April to June.**

FIG. 543. **POA FENDLERIANA** (Steud.) Vasey, U. S. Dept. Agr. Div. Bot. Bul. 13: 74. *pl. 74.* 1893, in part. (*Eragrostis fendleriana* Steud. Syn. Pl. Gram. 278. 1854.) FENDLER'S BLUE-GRASS, MUTTON-GRASS.—An erect, cæspitose perennial 3–6 dm. (1°–2°) high, with numerous, rather narrow basal leaves and narrow panicles 4–8 cm. (1½′–3′) long. Spikelets (*a*) 4- to 8- flowered, 7–8 mm. (3½″–4″) long; empty glumes unequal, the first 1-nerved, the second 3-nerved, about 4 mm. (2″) long; flowering glumes pubescent on the keel and marginal nerves below, otherwise smooth.—Mesas and dry hills, Colorado to Arizona and California. April to June.

Var. ARIZONICA Williams, U. S. Dept. Agr. Div. Agros. Cir. **10**: 5. 1899. Differs from the type in being strongly glabrous throughout, with longer, rougher leaves, and more unequal empty glumes. For a full discussion of the species in this group see Circular **10**, Div. of Agros. 1899.

This species is one of the most valuable native forage grasses in the regions where it grows and may prove valuable in cultivation.

FIG. 544. **POA COMPRESSA** Linn. Sp. Pl. 69. 1753. CANADA BLUE-GRASS.—A slender but rather rigid, and somewhat wiry perennial, with strongly flattened stems 1.5–5 dm. ($\frac{1}{2}°$–$1\frac{2}{3}°$) high, and usually small, narrow, few-flowered **panicles.** **Spikelets** (*a*) **3- to 5- (rarely 7- to 9-)** flowered, 4–6 mm. (2‴–3‴) long, with acute 3-nerved empty glumes and rather firm, obscurely nerved **flowering glumes** (*b*) **2–3 mm.** (1‴–$1\frac{1}{3}$‴) long, which are sparingly pubescent toward the base. A transverse section of a portion of a leaf is shown by *d* and a section of the culm by *c*, showing its strongly compressed **character** and presence of pith.—Dry meadows and waste places, **Newfoundland to South** Carolina, Tennessee, and westward. (Europe.) May to September.

This species is at once distinguished from related forms by its habit of growth and its strongly compressed culms; it grows well on the very poorest soils, and **is especially** valuable for permanent pastures.

FIG. 545. **POA BOLANDERI** Vasey, Bot. Gaz. **7** : 32. 1882. BOLANDER'S SPEAR-GRASS.—A smooth, loosely tufted erect perennial 3–6 dm. (1°–2°) high, with short, flat leaves and spreading **panicles 8–12 cm.** (3′–5′) **long. Sheaths** smooth, close, shorter than the rather long internodes; ligule obtuse 3–4 mm. (1⅛″–2″) long; leaf-blades 5–10 cm. (2′–4′) long, 3–4 mm. (1⅓″–2″) wide, flat, thin, smooth. Spikelets (*a*) 1- to 3- flowered, 3–4 mm. (1⅓″–2″) long; empty glumes unequal, smooth, the first 1-nerved, the second obscurely 3-nerved, longer than the first but not equaling the first flowering glume; flowering glumes ovate-oblong, about 2.5 mm. (1¼″) long and nearly smooth except for a slight web at the base.—Mountains of California and Oregon. March to August.

Fig. 546. **POA NEMORALIS** Linn. Sp. Pl. 69. 1753. **NORTHERN SPEAR-GRASS or WOOD MEADOW-GRASS.**—A slender, erect and rather rigid perennial 1.5–6 dm. high, with narrow, flat leaves and usually open panicles 4–10 cm. (1½′–4′) long. Sheaths smooth; ligule truncate 1–2 mm. (½″–1″) long or wanting; leaf-blades 2.5–8 cm. (1′–3′) long, 2 mm. (1″) wide or less, glabrous. Spikelets 2 to 5 flowered, 3–5 mm. (1½″–2½″) long, with very acute empty glumes (a) and faintly nerved flowering glumes (b) which are 2–3 mm. (1″–1½″) long, webbed at the base, and scabrous on the keel and margins below. The palea is shown by c.—Dry or rather moist soil, Labrador and Newfoundland to Pennsylvania, westward to British Columbia, Idaho, and Colorado. (Europe, Asia.) June to September.

FIG. 547. **POA LETTERMANI** Vasey, Contr. U. S. Nat. Herb. 1: 273. 1893. LETTERMAN'S BLUE-GRASS.—A densely tufted, low perennial 0.5–1 dm. (2'–4') high, with loose sheaths, short, flat leaves and oblong rather densely-flowered panicles 1–2 cm. ($\frac{1}{2}$'–$\frac{3}{4}$') long. Lower sheaths very loose; ligule rather conspicuous, obtuse; leaf-blades 2.5–5 cm. (1'–2') long, 1–2 mm. ($\frac{1}{2}$"–1") wide, mostly radical. Spikelets 3–4 mm. (1$\frac{1}{2}$"–2") long, with rather broad and nearly equal empty glumes (*a*) exceeding in length the adjacent flowering glumes; flowering glumes (*b*) 2–3 mm. (1"–1$\frac{1}{2}$") long, obtuse, obscurely nerved, smooth, scarious at the apex. Palea (*c*) nearly equaling the glume, 2-toothed at the acuminate apex.—Summits of high mountains, Colorado. July, August.

FIG. 548. **POA PATTERSONI** Vasey, Contr. U. S. Nat. Herb. 1: 275. 18[illegible]
PATTERSON'S BLUE-GRASS.—A low, densely-tufted perennial, 1–1.5 [illegible] (4′–6′) high, with numerous basal leaves, 4–6 cm. (1⅗′–2⅖′) long, and [illegible] densely-flowered panicles. Sheaths loose; leaf-blades flat or condupl[illegible] smooth, 1–8 cm. (½′–3′) long. Spikelets 2- to 3-flowered, 4–6 mm. (2″–3[illegible] [illegible] empty glumes (*a*) acute, nearly as long as the flowering glumes; flower[illegible] glumes (*b*) 4 mm. (2″) long, purplish, acute, pubescent on the lateral [illegible] and keel below the middle, but not webbed. Palea (*c*) three fourths as [illegible] the glume, pubescent in the keels.—High mountains of Colorado. August.

FIG. 549. **POA PRINGLEI** Scribn. Bul. Torr. Bot. Club, **10**: 31. 1883. PRINGLE'S BLUE-GRASS.—A densely tufted perennial from a creeping rootstock, with rather firm, spreading, smooth, narrow leaves and slender, scape-like culms 1-1.5 dm. (4′-6′) high. Leaf-blades mostly radical 2.5-5 cm. (1′-2′) long, convolute, rigid, recurved. Panicles contracted, few-flowered, usually about 2 cm. (¾′) long. Spikelets 3- to 5- flowered, 6-8 mm. (3″-4″) long; empty glumes (*a*) thin, membranceous, ovate-lanceolate, nearly as long as the flowering glumes (*b*), which are about 6 mm. (3″) long, smooth, obscurely 5-nerved. Palea (*c*) slightly shorter than the glume, scabrous on the keels.—Moist places, high mountains, California and (?) Oregon and Washington. August, September.

Fig. 550. POA LECKENBYI Scribn. U. S. Dept. Agr. Div. Agros. Cir. 9:2. 1899.
SAND BLUE-GRASS.—A pale green, tufted perennial 6–9 dm. (2°–3°) high, wi[th] long, narrow, flat leaves, somewhat inflated, **persistent basal sheaths**, and p[ale] rather narrow panicles 10–15 cm. (4′–6′) long. **Spikelets oblong-lance**[olate], **5- to 6- flowered, 9–11 mm.** (4½″–5½″) long, with subequal, 3-nerved, acute, e[m]... glumes (*a*) which slightly exceed the lower flowering glumes (*b, c*) which a[re] **5–6 mm.** (2½″–3″) long, often erose-dentate above and pubescent on the ba[se] below, **especially on the keel and marginal nerves.**—Dry and very sandy soil, Washington. June.

This grass grows on very sandy soils and is an excellent sand binder at [the] the same time a valuable hay grass. It somewhat resembles *Poa nevadensis* but **may be easily distinguished by its inflated membranaceous sheaths**, larg[er] spikelets, and pubescent, flowering glumes.

FIG. 551. **POA NEVADENSIS** Vasey in Scribn. Bul. Torr. Bot. Club, **10**: 66. 1883. NEVADA BLUE-GRASS.—An erect, rather stout perennial about 6 dm. (2°) high, with flat leaves and narrow panicles 10–25 cm. (4′–10′) long. Culm scabrous below the panicle; sheaths scabrous; leaf-blades very narrow, scabrous, 15–30 cm. (6′–12′) long. Spikelets lanceolate-oblong, 3- to 8- flowered, 6–12 mm. (3″–6″) long, with slightly unequal empty glumes (*a*) and oblong-elliptical, usually obtuse, flowering glumes (*b*) which are 4–5 mm. (2″–2½″) long, obscurely nerved, scarious on the margins above, and with few short hairs at the base, strongly scabrous on the keel.—Moist soil, North Dakota to British Columbia, and southward to Nebraska, Nevada, and California. May to August.

FIG. 552. **POA LUCIDA** Vasey, Contr. U. S. Nat. Herb. 1: 274. 1893. YELLOW SPEAR GRASS.—A slender, tufted perennial 4.5–6 dm. (1½°–2°) high, with flat leaves and narrow but lax panicles 10–15 cm. (4′–6′) long. Radical leaves 12–18 cm. (5′–7′) long, 2–4 mm. (1″–2″) wide, those of the culm shorter; ligule white 4 mm. (2″) long, decurrent. Spikelets (a) 6–8 mm. (3″–4″) long, 3- to 4-flowered, empty glumes (a) abruptly acute or obtuse, unequal 3–4 mm. (1½″–2″) long, smooth, slightly compressed, scarious at the apex and on the margins; flowering glumes (a) 4 mm. (2″) long and slightly pubescent on the keel and lateral nerves near the base, sparsely and minutely scabrous, 5-nerved. Palea equaling the glume.—**Dry, rocky places, moist brooksides, canyons, etc.,** alt. 1,500–3,300 m.; mountains of Colorado, Wyoming, Montana, and British Columbia. **July to September.**

FIG. 553. **POA UNILATERALIS** Scribn. in Vasey, U. S. Dept. Agr. Div. Bot. Bul. **13**: 85, *pl.* 85. 1893. ONE-SIDED BLUE-GRASS.—An erect, densely tufted, leafy perennial, 2.5–5 dm. (10′–20′) high, with soft, narrow, basal leaves and densely flowered, usually one-sided panicles 2–6 cm. (¾′–2¼′) long. Sheaths loose, scarious; leaf-blades thin, slender, flexible, 5–12 cm. (2′–5′) long, 2 mm. (1″) wide or less. Spikelets 4- to 7- flowered, about 10 mm. (5″) long; empty glumes (*a*) acute, carinate, hispid on the keel, minutely serrulate on the margins, 1- to 3- nerved, 3–6 mm. (1½″–3″) long; flowering glumes 4 mm. (2″) long, a little pubescent near the base, but not webbed. Palea (*b*) pubescent on the keels, nearly equaling the glumes.—Bluffs along the coast, California. April, May.

FIG. 554. **POA GRACILLIMA** Vasey, Contr. U. S. Nat. Herb. 1: 272. 1893. SLENDER SPEAR GRASS.—A smooth, densely tufted, erect perennial 1.5-5 dm. (15′-20′) high, with soft, narrow, flat leaves and open panicles 8-10 cm. (3′-4′) long. Radical leaves mostly fine, flaccid, and spreading, 5-12 cm. (2′-5′) long, those of the culm shorter. Spikelets (a) 3 to 5 flowered, 6-8 mm. (3″-4″) long, with rather distant florets, empty glumes acute, unequal, shorter than the adjacent florets, flowering glumes 3-4 mm. (1½″-2″) long, scabrous or pubescent on the keel and nerves below, scarious at the apex, purplish, slightly compressed, distinctly 5-nerved.—Dry, rocky soil on ridges and mountain sides central and northern California to Washington and British Columbia. May to August.

Fig. 555. **POA CUSICKII** Vasey, Contr. U. S. Nat. Herb. 1: 271. 1893. CUSICK'S BLUE-GRASS.—A densely caespitose, glabrous perennial 3–4 dm. (6′–10′) high, with very narrow leaves and contracted panicles 6–10 cm. (2½′–4′) long. Radical leaves numerous, filiform, not rigid, 7–12 cm. (3′–5′) long, 1 mm. (⅛″) or less wide. Spikelets (*a*) 3- to 5-flowered, 8–10 mm. (4″–5″) long; empty glumes about 4 mm. (2″) long, scarious margined, about one-half as long as the adjacent florets; flowering glumes (*b*) 5–6 mm. (2½″–3″) long and finely scabrous on the back, at least below, lanceolate, acute; not pubescent or webby at the base.—In canyons, Oregon and Idaho. May, June.

FIG. 556. **POA NUDATA** Scribn. U. S. Dept. Agr. Div. Agros. Cir. **9**: 1. 1899. (*Poa capillaris* Scribn. ibid., Bul. **11**: 51, *f. 11.* 1898. Not Linn. 1753.) FINE-LEAFED BLUE-GRASS.—A slender, erect, densely caespitose perennial 3-4 dm. (12′-16′) high, with capillary, flexuous basal leaves and long-exserted, densely flowered panicles 3-5 cm. (1¼′-2′) long. Basal leaves 3-6 cm. (1¼′-2½′) long, about 1 mm. (½″) wide, scabrous above, those of the culm shorter, about 2 mm. (1″) wide. Spikelets (*a*) 3 to 5 flowered, 7-10 mm. (3½″-5″) long, with broadly lanceolate, acute empty glumes; flowering glumes (*b*) 4-5 mm. (2″-2½″) long, scabrous on the keel and minutely scabrous throughout, slightly hairy near the base with very short, appressed hairs.—California.

FIG. 557. **POA PADDENSIS** Williams nom. nov. (*Poa purpurascens* Vasey, Bot. Gaz. **6**: 297. 1881. Not Spreng. Nov. Prov. 33. 1819.) PURPLE-TOP BLUE-GRASS.—**A tufted, erect, somewhat wiry perennial 2.5–3.5 dm.** (10′–14′) high, with flat leaves and rather densely flowered panicles 4–6 cm. ($1\frac{1}{2}$′–$2\frac{1}{2}$′) long. Spikelets ovate, 3- to 5- flowered, 5–7 mm. ($2\frac{1}{2}$″–$3\frac{1}{2}$″) long; empty glumes (*a*) smooth, 1- or obscurely 3- nerved, 3–4 mm. ($1\frac{1}{2}$″–2″) long; flowering glumes (*b*, *c*) obtuse, minutely scabrous on the back and hispid-ciliate on the keel, 5-nerved, 5–6 mm. ($2\frac{1}{2}$″–3″) long.—Moist hillsides and meadows, California northward to British Columbia. July, August.

The name is from Mount Paddo, where the species was first collected.

FIG. 558. **POA TENERRIMA** Scribn. U. S. Dept. Agr. Div. Agros. Cir. 9: 4. 1899. SLENDER-FLOWERED BLUE-GRASS.—A very slender, erect, caespitose perennial 3–5 dm. (1°–1⅔°) high, with short, filiform leaves and spreading, capillary panicles 7–9 cm. (2½′–3½′) long. Leaves of the intravaginal innovations 4–8 cm. (1½′–3′) long, threadlike, those of the culm shorter, involute, smooth. Spikelets 3- to 4-flowered, about 7 mm. (3½″) long; empty glumes acute, the first about 2.5 mm. (1¼″) long, somewhat shorter and narrower than the second; flowering glumes smooth excepting for a short, crisp pubescence near the base, about 4 mm. (2″) long.—California.

FIG. 559. **POA VASEYOCHLOA** Scribn. U.S. Dept. Agr. Div. Agros. Cir. 9: 1. 1899. (*P. pulchella* Vasey. 1882. Not Salisb., nor Parl.) **VASEY'S BLUE-GRASS.**—A slender, cæspitose perennial, with short, filiform leaves, smooth, erect culms 1–1.5 dm. (4′–6′) high, and delicate, open panicles 2–3 cm. (¾′–1¼′) long. Spikelets 3- to 5- flowered, 6–8 mm. (3″–4″) long; empty glumes (*a*) about 2 mm. (1″) long, 3-nerved, obtuse or somewhat erosely dentate at the apex; flowering glumes (*b*, *c*) about 4 mm. (2″) long, 3-nerved, finely scabrous on the keel and nerves, but not pubescent nor webbed at the base. Palea equaling the glume, bidentate and scabrous on the conspicuous nerves.—Moist places among rocks, Idaho, Washington, and Oregon. April, May.

FIG. 560. **POA ARGENTEA** Howell, Bul. Torr. Bot. Club, **15**: 11. 1888.
SILVERY BLUE-GRASS.—A slender, smooth, densely caespitose, erect perennial 1.5–2.5 dm. (6′–10′) high, with flat leaves and narrow, oblong, rather loosely flowered panicles 2–4 cm. (¾′–1½′) long. Sheaths loose, membranaceous, leaf-blades 5–7 cm. (2′–3′) long, numerous and crowded below. Spikelets (*a*) oblong-lanceolate, 2- to 3-flowered, 6–9 mm. (3″–4½″) long; empty glumes about 5 mm. (2½″) long, obtuse, denticulate at the apex, broadly scarious margined, smooth; flowering glumes (*b*) 4–7 mm. (2″–3½″) long, scarious margined, smooth or minutely scabrous. Palea nearly as long as the glume.—In the mountains of western Oregon. July.

Fig. 561. **POA GLUMARIS** Trin. Mém. Acad. St. Pétersb. VI. Sci. math. Phys. et Nat. 1: 379. 1831. LARGE-FLOWERED BLUE-GRASS.—A stout, erect, smooth, glaucous perennial 3–9 dm. (1°–3°) high, from strong, creeping rootstocks, with thick, flat leaves, closely flowered, contracted panicles 8–16 cm. (3′–6½′) long. Spikelets 3- to 5- flowered, 8–12 mm. (4″–6″) long, with nearly equal, acute, firm, empty glumes (*a*), the second 7–8 mm. (3½″–4″) long, somewhat exceeding the first: flowering glumes (*b*) 4–5 mm. (2″–2½″) long and pubescent on the margins and keel below; not webbed. Palea (*c*) pubescent on the nerves.—Nova Scotia, Quebec, and westward to Alaska. May to September.

FIG. 562. **POA DOUGLASSII** Nees, Ann. Nat. Hist. **1**: 284. 1838. (*Brizopyrum douglassii* Hook. & Arn.) DOUGLASS' SAND-GRASS.—A slender, tufted perennial 1.5–3 dm. (½°–1°) high, from long, creeping rootstocks, with numerous convolute radical leaves, flat culm leaves, and densely flowered, capitate panicles 2–4 cm. (¾'–1½') long. Spikelets 3- to 5-flowered, about 8 mm. (4''') long, with acute empty glumes (*a*, *c*) and acute flowering glumes, which are 6 mm. (3''') long, ciliate-pubescent on the keel above, and softly hairy or more or less crisp-hairy below.—In sands along the coast, California and northward. May.

An excellent sand binder. Distinguished from *P. macrantha* Vasey, by its smaller size, softer, more slender leaves, more contracted inflorescence, smaller, more delicate, ovate flowering glumes, not scabrous on the back. It is closely allied to *P. fulvescens* Trin.

FIG. 563. **COLPODIUM PENDULINUM** (Laest.) Griseb. in Ledeb. Fl. Ross. 4: 386. 1853. (*Glyceria pendulina* Laest. in Wahl. Fl. Suec., ed. 2, 1088. 1833.) NODDING COLPODIUM.—A smooth, erect perennial 6–7.5 dm. (2°–2½°) high, with flat leaves and open, nodding panicles about 12 cm. (5′) long. Sheaths close, overlapping, smooth; ligule membranaceous, truncate, 3 mm. (1½″) long or less; leaf-blades smooth, 10–20 cm. (4′–8′) long, 3–4 mm. (1½″–2″) wide. Spikelets (*a*) oblong, 4- to 6- flowered, 4–6 mm. (2″–3″) long, with smooth, nearly equal empty glumes; flowering glumes (*b*) broadly ovate-oblong, 3–3.5 mm. (1½″–1¾″) in length, erose at the thin, membranaceous apex, smooth, except for a few short hairs at the base. Palea less than 2 mm. (1″) long, 2-lobed at the apex.—Moist banks, British America and Alaska. (Northern Europe.) July, August.

FIG. 564. **COLPODIUM FULVUM** (Trin.) Griseb. in Ledeb. Fl. Ross. **4**: 3 1853. (*Poa fulva* Trin. Mém. Acad. St. Pétersb. VI, Sci. math. phys. et nat. 1: 378. 1831: *Graphephorum fulvum* A. Gray.) YELLOW COLPODIUM.—A rather stout, erect, leafy, and glabrous perennial 2–6 dm. (⅔°–2°) high, with **sharp-pointed leaves and open panicles 8–15 cm. (3′–6′) long.** Sheaths ra loose, imbricate; ligule lacerate, about 3 mm. (1½″) long; leaf-blades 5–25 (2′–10′) long, 5–8 mm. (2⅓″–4″) wide, pungent pointed or sometimes obt **Spikelets 4- to 6- flowered, 5–6 mm. (2⅓″–3″) long,** with broadly lance empty glumes (*a*) and obtuse flowering glumes (*b*) about 4 mm. (2″) long.— **Moist situations, British Columbia to Alaska.** (Greenland and north **Europe.**) **August.**

FIG. 565. **DUPONTIA PSILOSANTHA** Rupr. Fl. Samoj. Cisural. 65. *t. 6.* 1845. (*Graphephorum fisheri psilosanthum* A. Gray.) SLENDER DUPONTIA.—A slender, erect, glabrous perennial 1.5-4 dm. ($\frac{1}{2}$°-$1\frac{1}{3}$°) high, from a creeping rootstock, with flat, attenuate-pointed leaves and contracted or, in anthesis, spreading panicles 7-12 cm. (3′-5′) long. Spikelets 2- to 3- flowered, 6-7 mm. (3″-$3\frac{1}{2}$″) long, with broad and usually obtuse empty glumes (*a*) and obovate, obtuse, glabrous flowering glumes (*b*) which are 3-nerved and slightly shorter than the empty glumes.—Newfoundland, Hudson Bay to Alaska. (Arctic-Siberia.) August, September.

Fig. 566. **DUPONTIA FISHERI** R. Br. Suppl. App. Parry's Voy. 291. 1824.

FISHER'S DUPONTIA.—A slender, erect perennial 1–2.5 dm. (4′–10′) high, from a creeping rootstock, with flat, attenuate-pointed leaves and contracted, simple panicles 4–7 cm. (1½′–2¾′) long. Sheaths glabrous; ligule 2 mm. (1″) long or less truncate; leaf-blades 5–13 cm. (2′–5′) long, 2–4 mm. (1″–2″) wide, glabrous. Spikelets 2- to 3- flowered, 6–7.5 mm. (3″–3¾″) long, with lanceolate, acute empty glumes (*a*) and obtuse or acute flowering glumes (*b*), which are silky-pilose on the back toward the base.—Moist situations, Arctic America. (Siberia.) June to August.

FIG. 567. **SCOLOCHLOA FESTUCACEA** (Willd.) Link, Hort. Berol. **1**: 137. 1827. (*Arundo festucacea* Willd. Enum. **1**: 126. 1809.) SPRANGLE-TOP.—A stout, erect, glabrous perennial 9–15 dm. (3°–5°) high, with long, flat leaves and open panicles 16–30 cm. (6′–12′) long. Sheaths glabrous; ligule 4 mm. (2″) long; leaf-blades about 30 cm. (12′) long, 6–8 mm. (3″–4″) wide, scabrous on the margins. Spikelets 3- to 5- flowered, 6–8 mm. (3″–4″) long; empty glumes (*a*) thin, unequal, the second about 8 mm. (4″) long, 5-nerved, denticulate at the apex; flowering glumes (*b*) 7-nerved, usually truncate and 3- to 5- dentate at the apex, and **with a tuft of hairs at the base.**—Wet grounds or in shallow water, Minnesota, Iowa to Nebraska, and northward. (Northern Europe.) June to August.

FIG. 568. **PANICULARIA ACUTIFLORA** (Torr.) Kuntze, Rev. Gen. Pl. 2: 782. 1891. (*Glyceria acutiflora* Torr. Fl. U. S. 1 : 104. 1824.) ACUTE-FLOWERED MANNA-GRASS.—A rather slender, glabrous perennial 3-6 dm. (1°-2°) high, with flat leaves and narrow, simple panicles 15-30 cm. (6'-12') long. Sheaths mostly smooth, generally exceeding the internodes; leaf-blades 7.5-15 cm. (3'-6') long, 4-6 mm. (2"-3") wide, smooth beneath, **scabrous** above. Spikelets (*a*) narrow, 24-42 mm. (12"-21") long, 5- to 12- flowered; empty glumes unequal, acute; flowering glume (*b*) scabrous, acute, about 8 mm. (4") long, **exceeded by the long-acuminate palea, which** is bidentate or cleft at the apex.—Wet soil and in shallow water, Maine to Ohio, and southward to New Jersey and Tennessee. May, June.

This species is at once distinguished by its acute glumes and long-acuminate, **bidentate paleas.**

FIG. 569. **PANICULARIA BOREALIS** Nash, Bul. Torr. Bot. Club, **24**: 348. 1897. (*Glyceria fluitans angustata* Vasey, Proc. Port. Soc. Nat. Hist., **2**: 91. 1895. Not *G. angustata* Fries, 1869.) NORTHERN MANNA-GRASS.—A rather slender, smooth perennial 4–15 dm. ($1\frac{1}{3}°$–$5°$) high, with flat leaves and narrow panicles 12–40 cm. (5′–16′) long. Sheaths overlapping, smooth or scabrous, the upper one inclosing the base of the panicle; ligule 5–15 mm. ($2\frac{1}{3}''$–$7\frac{1}{2}''$) long; leaf-blades linear, 9–50 cm. ($3\frac{1}{2}'$–20′) long, 2–10 mm. (1″–5″) wide. Spikelets (*a*) 10–18 mm. (7″–9″) long, 7- to 13- flowered; empty glumes unequal, very smooth, 1-nerved; flowering glumes (*b*) thin, 4–5 mm. (2″–$2\frac{1}{2}''$) long, 7-nerved, hispidulous on the nerves, broadly scarious-margined at the obtuse and erose apex. Palea hyaline, obtuse, slightly shorter than the glume.—Margins of streams and ponds, New England and New York, westward to Washington and California. June to September.

Distinguished from *Panicularia fluitans* (L.) Kuntze, by its smaller spikelets and thin flowering glumes, which are hispidulous on the nerves only.

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FIG. 570. **PANICULARIA OBTUSA** (Muhl.) Kuntze, Rev. Gen. Pl. 2: 783. 1891. (*Poa obtusa* Muhl. Gram. 147. 1817.) DENSELY FLOWERED MANNA-GRASS.—A stout, erect, glabrous grass 3–9 dm. (1°–3°) high, with rather broad flat leaves and contracted, many-flowered panicles 6–18 cm. (2½′–6′) long. Sheaths smooth, striate, the lower ones overlapping; ligule very short or obsolete; leaf-blades 8–35 cm. (3′–14′) long, 4–6 mm. (2″–3″) wide, somewhat scabrous. Spikelets 3- to 7- flowered, 4–6 mm. (2″–3″) long; empty glumes [illegible] 1-nerved, obtuse, scarious, the second 2.5 mm. (1¼″) long, exceeding the first; flowering glumes (*b*) about 3 mm. (1½″) long.—Wet, swampy places, New Brunswick to New York and Pennsylvania, south to Virginia and North Carolina. July to October.

FIG. 571. **PUCCINELLIA DISTANS** (Linn.) Parl. Fl. Ital. 1: 367. 1848. (*Poa distans* Linn. Mant. 1: 32. 1767.) SPREADING SPEAR-GRASS.—A slender, erect or sometimes decumbent, tufted, glabrous perennial 3–6 dm. (1°–2°) high, with flat leaves and diffusely spreading panicles 5–18 cm. (2′–7′) long, branches often becoming finally deflexed. Spikelets 3- to 6- flowered, 3–5 mm. ($1\frac{1}{2}''$–$2\frac{1}{2}''$) long; empty glumes (*a*) obtuse or acute, 1-nerved; the second exceeding the first and about one-half as long as the first flowering glume; flowering glumes (*b*) obtuse, obscurely nerved, 1–2 mm. ($\frac{1}{2}''$–$1''$) long. A transverse section of a leaf-blade is shown by *c*.—Saline soils, Nova Scotia to New Jersey and Pennsylvania, and on the west coast from California to Alaska. (Europe, Asia.) June to August.

FIG. 572. **PUCCINELLIA LEMMONI** (Vasey) Scribn. U.S. Dept. Agr. Div. Agros. Bul. **17**: 276, *f. 572.* 1899. (*Poa lemmoni* Vasey, Bot. Gaz. **3**: 13. 1878.)

LEMMON'S SPEAR-GRASS.—A tufted, pale-green or glaucous perennial, with slender, smooth, and somewhat wiry upright culms 3-4.5 dm. (1°-1½°) high with numerous, short basal leaves and spreading panicles 6-10 cm. (2½'-4') long. Spikelets very narrow, 3- to 7- flowered, 4-6 mm. (2''-3'') long; empty glumes (a) unequal, the second two-thirds as long as the flowering glumes (*b*), which are about 2 mm. (1'') long, convex on the back, and very finely pubescent or minutely scabrous.—Alkali flats, Nevada and California to Vancouver Island, **Alberta, and Assiniboia.** June, July.

FIG. 573. **FESTUCA KINGII** (S. Wats.) Scribn. U. S. Dept. Agr. Div. Agros. Bul. **5**: 36. 1897. (*Poa kingii* S. Wats. King's Explor. 40th Par. **5**: 387. 1871; *Festuca confinis* Vasey, Bul. Torr. Bot. Club, **11**: 126. 1884.) KING'S FESCUE.—A stout, erect, strongly cæspitose perennial 6–9 dm. (2°–3°) high, with rigid culms, long, narrow leaves, and contracted panicles 8–10 cm. (3′–4′) long. Sheaths loose, shorter than the internodes; ligule scarious, obtuse; leaf-blades flat, about 15 cm. (6′) long, 3 mm. (1½″) wide. Spikelets (*a*) 3- to 5- flowered, 6–8 mm. (3″–4″) long, with ovate-lanceolate, thin, acute outer glumes, and scabrous, rather rigid, prominently 3-nerved flowering glumes (*b*) about 6 mm. (3″) long, which are acute but not awned.—Dry mountain sides, Montana to Oregon and south to Colorado and Nevada. May to August.

FIG. 574. **FESTUCA OBTUSA** Spreng. Mant. Fl. Hal. 34. 1807. (*F. shortii* Kunth in Wood's Classbook, 794. 1861.) SHORT'S FESCUE.—A rather stout, erect, glabrous perennial 6–12 dm. (2°–4°) high, with flat leaves and rather narrow, nodding panicles 8–16 cm. (3′–6′) long. Sheaths smooth; ligule very short; leaf-blades 10–18 cm. (4′–7′) long, 4–5 mm. (2″–2½″) wide, acute, scabrous. Spikelets broadly obovate, 3- to 6- flowered, 5–6 mm. (2½″–3″) long; empty glumes (*a*) unequal, the first 1-nerved, the second 3-nerved, about the length of the approximate flowering glume; flowering glumes (*b*) 4–5 mm. (2″–2½″) long, rounded on the back, obscurely nerved.—Open woods and thickets, Pennsylvania to Illinois, Tennessee, Kansas, Mississippi, and Texas. July, August.

FIG. 575. **FESTUCA JONESII** Vasey, Contr. U. S. Nat. Herb. **1**: 278. 1893.
JONES'S FESCUE.—An erect, usually slender, cæspitose, leafy perennial 6–12 dm. (2°–4°) high, with flat leaves 10–25 cm. (4′–10′) long, and open, nodding panicles 15–30 cm. (6′–12′) long. Sheaths shorter than the internodes; ligule short, obtuse; leaf-blades 4–8 mm. (2″–4″) wide, attenuate. Spikelets about 12 mm. (6″) long, including the awns, 3- to 5- flowered, with unequal, acute empty glumes (*b*) 4–5 mm. (2″–2½″) long, the first one-third shorter than the second; flowering glumes (*a*) about 5 mm. (2½″) long, lanceolate-acuminate, 3-nerved, minutely scabrous, terminated with a slender awn longer than the glume.—Moist places near springs and borders of woodlands in the mountains, Wyoming, Utah, California to Vancouver Island, and Alaska. June to August.

Fig. 576. **FESTUCA DASYCLADA** Hack. in Beal, Grasses N. A. **2**: 602. 1896.
HACKEL'S FESCUE.—A slender perennial 2–4 dm. (8′–16′) high, the culms often geniculate below, with smooth sheaths, narrow leaves, and ovoid-pyramidal panicles 7–12 cm. (3′–5′) long. Sheaths smooth, shorter than the internodes; ligule short, auriculate; leaf-blades involute, 10–15 cm. (4′–6′) long, 2 mm. (1″) wide. Spikelets usually 2-flowered, about 7 mm. (3½″) long; empty glumes (*b*) unequal, the second 3-nerved, 6 mm. (3″) long; flowering glumes (*a*) scabrous, 5-nerved, 6 mm. (3″) long, bearing an awn about 3 mm. (1½″) long.—Southern California and (?) Utah, rare.

FIG. 577. **FESTUCA OVINA** Linn. Sp. Pl. 73. 1753. SHEEP'S FESCUE.—A slender, densely tufted, erect perennial 2–6 dm. (⅔°–2°) high, with narrow or filiform, involute leaves and contracted (expanding while in bloom) panicles 3–6 cm. (1¼′–2½′) long. Spikelets 3- to 5-flowered, with unequal empty glumes (*a*) and usually short-awned, smooth or scabrous flowering glumes (*b*) 3–4 mm. (1½″–2″) long.—New England to Pennsylvania and westward to the Pacific. (Europe, Asia.) June to September.

An exceedingly variable species having many well-marked varieties, reaching its greatest development in value and in the number of varieties in the Rocky Mountain region. It has been only sparingly introduced into cultivation in this country, but is especially valuable for sheep pastures and is well suited to light, dry soils.

FIG. 578. **FESTUCA MICROSTACHYS** Nutt. Journ. Acad. Nat. Sci. Phila. II 1: 187. 1848. SMALL-TOPPED FESCUE.—A slender, cæspitose annual 1–4 dm. (4′–16′) high, with narrow, filiform leaves and simple, racemose or spike-like panicles 2–10 cm. (¾′–4′) long. Sheaths smooth or pubescent, close; ligule wider than the leaf-blade, but very short; leaf-blades involute, 5–7 cm. (2′–3′) long. **Spiklets 1- to 5- flowered, 7–10 mm. (3½″–5″) long; empty glumes** (*a*) **nearly equal,** smooth or thinly pubescent, the second more than one-half as long as the adjacent floret; **flowering glumes** (*b*) 4–6 mm. (2″–3″) long, roughly pubescent or nearly smooth, bearing a hispid awn 6–10 mm. (3″–5″) long.—Utah, Nevada, and Idaho to Vancouver Island, southward to Arizona and southern California. April to June.

Fig. 579. **FESTUCA SCIUREA** Nutt. Trans. Amer. Phil. Soc. II. **5**: 147. 1837.—A slender, erect, cæspitose annual 1.5–5 dm. (½°–1⅔°) high, with short, filiform leaves and narrow, simple panicles 5–20 cm. (2′–8′) long. Sheaths close, about equaling the internodes; leaf-blades involute-setaceous, 1–4 cm. (½′–1½′) long. Spikelets 4–6 mm. (2″–3″) long, 3- to 7- flowered, with unequal empty glumes (*a*), the second 3-nerved, and very narrow flowering glumes (*b*), which are pilose, especially above, and terminated in slender awns 8–12 mm. (4″–6″) long.—Arkansas, Indian Territory, Mississippi, and Texas.

Distinguished from *F. octoflora* by its pilose flowering glumes and longer awns.

FIG. 580. **FESTUCA OCTOFLORA** Walt. Fl. Car. 81. 1788. (*Festuca tenella* Willd. Enum. 1 : 113. 1809.) SLENDER FESCUE.—A slender, erect, more or less cæspitose annual 1–5 dm. (4′–20′) high, with narrow, simple panicles 2–15 cm. (¾′–6′) long. Sheaths usually shorter than the internodes; ligule very short; leaf-blades 4–8 cm. (1½′–3′) long, involute. Spikelets 5- to 13- flowered, 6–10 mm. (3″–5″) long, with slightly unequal, acute empty glumes (*a*) and narrow, usually scabrous, short-awned or nearly awnless flowering glumes (*b*) 3–5 mm. (1½″–2½″) long.—Dry, sandy, gravelly, or rocky soil, from Canada to Florida and westward to Washington and California. May to August.

Fig. 581. **FESTUCA MYUROS** Linn. Sp. Pl. 74. 1753. **RAT'S-TAIL FESCUE.**—A smooth, slender, erect annual 3–6 dm. (1°–2°) high, with narrow, involute leaves and contracted, **usually one-sided** panicles 8–25 cm. (3′–10′) long. Spikelets 3- to 6- flowered, 8–12 mm. (4″–6″) long, **exclusive of the awns,** with very unequal, acute empty glumes (*a*), the first 1–2 mm. (½″–1″) long, the second 4–5 mm. (2″–2½″) long; flowering glumes (*b*) 4–6 mm. (2″–3″) long, scabrous above and **usually with few long hairs** on the margins; awns 8–12 mm. (4″–6″) long, much exceeding the glumes.—Fields and waste places, Massachusetts to Florida, and westward to California and Washington. (Europe.) April to July.

FIG. 582. **BROMUS CARINATUS HOOKERIANUS** (Thurb.) Shear, U. S. Dept. Agr. Div. Agros. Bul. **23** : 60. 1900. (*Bromus hookerianus* Thurb. in Wilkes's U. S. Expl. Exped. **17**²: 493. 1874; *Ceratochloa grandiflora* Hook. Fl. Bor. Am. **2**: 253. 1840.) HOOKER'S BROME.—A stout, erect perennial 3–12 dm. (1°–4°) high. Culms smooth. Sheaths usually shorter than the internodes, pubescent or smooth; leaf-blades flat, linear-lanceolate. Panicle erect, somewhat lax, 20–40 cm. (8′–16′) long. Spikelets (*a*) 5- to 10- flowered, 30–40 mm. (15″–20″) long, 5–7 mm. (2½″–3½″) broad, sparingly compressed; empty glumes acute, the lower 5- the upper 7- nerved; flowering glumes (*b*) seabrous, 7- to 9- nerved, with a **broad, hyaline margin**; awn 10–15 mm. (5″–7½″) long.—Thickets and borders of **fields, California to Washington and Idaho.** July, August.

This variety differs from the species in its larger spikelets and glumes and in having the flowering glume seabrous instead of pubescent.

FIG. 583. **BROMUS CILIATUS** L. Sp. Pl. 1: 76. 1753. (*Bromus canadensis* Mich. Fl. Bor. Am. 1: 65. 1803.)—A stout, leafy perennial 7–12 dm. (2°–4°) high, with pubescent or nearly smooth sheaths, thinly pilose leaves, and broadly pyramidal, nodding panicles 1.5–2.5 dm. (6′–10′) long. Culms smooth or slightly pubescent at the nodes. Ligule rarely exceeding 1 mm. (½″) in length. Leaf-blades 2.5–3.5 dm. (10′–14′) long, and about 10 mm. (5″) broad. Spikelets on slender, flexuous pedicels, 5- to 9- flowered, 15–22 mm. (7½″–11″) long; empty glumes (*a*) unequal, the first 1-nerved, 5–8 mm. (2½″–4″) long, the second 3-nerved, 8–11 mm. (4″–5½″) long; flowering glumes (*b*) narrow, oblong, lanceolate, obtuse, slightly 2-toothed at the apex, 5- to 7- nerved, 10–12 mm. (5″–6″) long, ciliate-pubescent near the margins, excepting near the apex. The palea is shown at *c*. Awns straight.—Newfoundland to New York and westward to Minnesota and Iowa and northward

Var. LÆVIGLUMIS Scribn. U. S. Dept. Agr. Div. Agros. Bul. 23: 32. 1900. Flowering glumes nearly smooth or with a very slight pubescence on the margins near the base.—Maine to North Carolina. (Canada.)

FIG. 584. **BROMUS KALMII** A. Gray, Man. Bot. 600. 1848. (*Bromus ciliatus* Muhl. Gram. 169. 1817. Not L. 1753; *Bromus purgans* Torr. Fl. N. Y. **2**: 468. 1843. Not L. 1753.)—A rather slender, erect perennial 4.5–9 dm. (1½°–2°) high, with usually pubescent sheaths and leaves and nodding, few-flowered panicles 5–15 cm. (2′–6′) long. Culms usually pubescent just below the nodes. Leaf-blades flat, 6–18 cm. (2⅓′–7′) long, 5–10 mm. (2½″–5″) broad. Panicle branches slender, flexuous, bearing 1 to 2 spikelets. Spikelets nodding, 7- to 13-flowered, 15–25 mm. (7½″–12½″) long; empty glumes coarsely pubescent, the first 3-nerved, 5–6 mm. (2½″–3″) long, the second 5-nerved, obtuse, 7–8 mm. (3½″–4″) long; flowering glumes obtuse, emarginate, rather densely silky-pubescent, 7-nerved, 8–10 mm. (4″–5″) long. Awns straight, 2–3 mm. (1″–1½″) long. Internodes of the rachilla pubescent.—New England to New York, westward to Minnesota and Wisconsin.

FIG. 585. **BROMUS HORDEACEUS** L. Sp. Pl. 77. 1753. (***B. mollis*** Linn. Sp. Pl. ed. 2, 112. 1762.) SOFT CHESS.—An erect or ascending annual or biennial 2–8 dm. ($\frac{2}{3}$°–$2\frac{2}{3}$°) high, usually somewhat pubescent at the nodes, with a rather dense, erect panicle. Sheaths retrorsely soft-pilose-pubescent; leaf-blades linear, pilose-pubescent or nearly smooth, 5–15 cm. (2′–6′) long, and 3–5 mm. ($1\frac{1}{4}$″–$2\frac{1}{2}$″) broad. Panicle contracted, 5–10 cm. (2′–4′) long, 2–4 cm. ($\frac{3}{4}$′–$1\frac{1}{2}$′) broad. Spikelets 5- to 15- flowered, ovate-lanceolate, 12–15 mm. (6″–$7\frac{1}{2}$″) long, 4–6 mm. (2″–3″) wide; empty glumes (*a*) broad, obtuse, coarsely pilose-pubescent; flowering glumes (*b*) broad, obtuse, 7-nerved, coarsely pilose-pubescent, 8–11 mm. (4″–$5\frac{1}{2}$″) long; awn rather stout, flattened toward the base, 6–9 mm. (3″–$4\frac{1}{2}$″) long.—Fields and waste places throughout the **United States.** (A native of southern Europe.)

Var. INTERMEDIUS (Guss.) Shear, U. S. Dept. Agr. Div. Agros. Bul. **23**: 19. 1900, differs from the species in its slightly larger spikelets and awns, which are twisted and divaricate when mature and dry. Var. GLABRESCENS (Coss.) Shear, l. c. 20, differs from the species in having the spikelets nearly or quite glabrous.

FIG. 586. **BROMUS TECTORUM** L. Sp. Pl. 1: 77. 1753. (*Schedonorus tectorum* Fr. Summ. Veg. Scand. 1: 76. 1846–1849.)—A low, tufted, cæspitose annual 3–6 dm. (12′–24′) high, with rather slender, smooth culms, pubescent sheaths, **narrow, mostly** pubescent leaves, and open, nodding panicles 6–15 cm. (2½′–6′) long. Spikelets nodding, 5- to 7- flowered, 12–20 mm. (6″–10″) long; empty glumes unequal, the first 1-nerved, the second 3-nerved, pubescent on the back; flowering glumes 5-nerved, 11–13 mm. (5½″–6½″) long, clothed with a short, pilose pubescence, 2-toothed at the apex. Awn straight or slightly divergent, about 14 mm. (7″) long.—Waste grounds from Massachusetts to Mississippi, westward to Oregon, Washington, and California. (A weed introduced from Europe.

FIG. 587. **LOLIUM TEMULENTUM** Linn. Sp. Pl. 83. 1753. DARNEL.—A glabrous, erect, and usually rather stout annual 6–12 dm. (2°–4°) high, with flat leaves and erect spikes 10–30 cm. (4′–12′) long. Culms generally seabrous below the spike; sheaths seabrous; ligule short; leaf-blades 10–25 cm. (4′–10′) long, 2–6 mm. (1″–3″) wide, smooth beneath, seabrous above. Spikelets 4- to 8-flowered, 10–18 mm. (5″–9″) long; the empty glume (*a*) strongly nerved, as long as or exceeding the spikelet; flowering glumes (*b*) turgid, obscurely nerved, awned or awnless.—Waste places and cultivated grounds, New Brunswick to Michigan and Georgia; abundant on the Pacific coast. Introduced from Europe. May to August.

Var. GLABERRIMA Kuntze, Rev. Gen. Pl. 2: 79. 1891, from California, has the culms smooth below the spikes.

In some sections this species is a troublesome weed. The grain has a narcotic effect upon man and flesh-eating animals.

FIG. 588. **LEPTURUS FILIFORMIS** (Roth) Trin. Fund. Agrost. 123. 1820. (*Rottbœllia filiformis* Roth, Cat. 1: 21. 1797.) SLENDER HARD-GRASS.—A slender and rather rigid, much-branched annual 1-3 dm. (4′-12′) high, with narrow, flat leaves, and slender, erect or curved spikes 2-12 cm. (¾′-5′) long. Sheaths shorter than the internodes; ligule very short, truncate, decurrent; leaf-blades 1-8 cm. (½′-3′) long, smooth below, scabrous above. Spikelets (*b*) 4-5 mm. (2″-2¼″) long, transverse to the rachis (*a*), with acute empty glumes, which are somewhat oblique, the first slightly longer than the second and more prominently 5-nerved; flowering glume (*c*) hyaline, 1-nerved, 5 mm. (2½″) long. Palea (*d*) about as long as the glume, bidentate. The lodicules are shown by *e*.—Waste places, southern Pennsylvania to Virginia. Introduced from Europe. May to July.

FIG. 589. **LEPTURUS INCURVATUS** (Linn.) Trin. Fund. Agrost. 123. 1820. (*Ægilops incurvata* Linn. Sp. Pl. 1051. 1753; *Rottboellia incurvata* Linn. Suppl. 114. 1781.) CURLY HARD-GRASS.—A low, much-branched annual 1–2 dm. (4′–8′) high, with narrow leaves and usually strongly incurved spikes 2–8 cm. (¾′–3′) long. Sheaths prominently striate, smooth, about as long as the internodes, scarious on the margins; ligule less than 2 mm. (1″) long, decurrent; leaf-blades 1–3 cm. (½′–1¼′) long, 2 mm. (1″) wide or less, becoming involute when dry. Spikelets (*b*) about 6 mm. (3″) long; empty glumes rigid, very acute, 5–6 mm. (2½″–3″) long, exceeding the hyaline flowering glume (*c*), which is 1-nerved, smooth, about 4 mm. (2″) long. The palea is shown by *d*.—Borders of brackish marshes, Maryland to southern Virginia, New Jersey (on ships' ballast), and California. Introduced from Europe.

FIG. 590. **AGROPYRON PARISHII** Scribn. & Smith, U. S. Dept. Agr. Div. Agros. Bul. **4**: 28. 1897. PARISH'S WHEAT-GRASS.—A rather stout, erect, caespitose perennial 6–10 dm. (2°–3⅓°) high, with flat leaves and erect or nodding spikes 15–30 cm. (6′–12′) long. Culms glabrous; nodes retrorsely pubescent. Spikelets remote, 5- to 7- flowered, 16–20 mm. (8″–10″) long; empty glumes [illegible] two-thirds as long as the spikelets, 5-nerved, scarious on the margins; flowering glumes (*b*) 9–11 mm. (4½″–5½″) long, flattened on the back below, prominently 5-nerved above, and scabrous toward the minutely 3-toothed, awnless or short-awned apex; awn, when present, 6–8 mm. (3″–4″) long.—Foothills, San Bernardino Mountains, California. May to June.

Var. LÆVE S. & S., l. c., is a form with the habit of the species, but with the nodes and sheaths glabrous.—Dry banks, San Diego County, California.

This species apparently connects *Agropyron* with *Brachypodium*. It is the only American species with pubescent culm nodes.

FIG. 591. **AGROPYRON VIOLACEUM** (Hornem.) Lange. Consp. Fl. Groenland. 154. 1880. (*Triticum violaceum* Hornem. in Fl. Dan. *t. 2044.* 1832.) NORTHERN WHEAT-GRASS.—An erect, cæspitose perennial, with rather short, flat leaves and comparatively stout spikes 2–6 cm. (¾′–2¼′) long. Spikelets 3- to 4- flowered; empty glumes (*a*) 8–12 mm. (4″–6″) long, usually purplish, scarious on the margins; flowering glumes (*b*) acuminate or awn-pointed, the awn rarely as long as the glumes.—Labrador and westward to Colorado and Utah, and northward to Alaska. June to September. (Northern Europe.)

Var. LATIGLUME S. & S., U. S. Dept. Agr. Div. Agros. Bul. **4**: 30. 1897, has rigid, wiry culms and oblanceolate empty glumes, which become flat with age; flowering glumes densely pubescent. Var. ANDINUM S. & S., l. c., is a weak, tufted form with short, compact spikes, with the awns equaling or exceeding the flowering glumes, which are 8–10 mm. (4″–5″) long.—Colorado.

FIG. 592. **AGROPYRON PSEUDOREPENS** Scribn. & Smith, U. S. Dept. Agr. Div. Agros. Bul. **4**: 34. 1897. FALSE COUCH-GRASS.—An erect, rather stout perennial 3-9 dm. (1°-3°) high, from creeping rootstocks, with flat, scabrous leaves and erect spikes 8-16 cm. (3′-6′) long. Spikelets 10-16 mm. (5″-8″) long, 3- to 7- flowered, with linear-lanceolate, nearly equal, and 5-nerved empty glumes (*a*) and acuminate or awn-pointed flowering glumes (*b*), which are rounded on the back, 5-nerved. Rather moist soil, Texas and Arizona to Nebraska, Montana, and British America. May to September.

Var. MAGNUM S. & S., l. c. 35, is a robust form 9-12 dm. (3°-4°) high, with longer leaves and spikes and crowded spikelets, which are 24 mm. (12″) long.—Colorado and Idaho.

This species has been confused with th *Agropyron repens* of Europe which has been sparingly introduced into the United States, but is readily distinguished from that species by its harsher leaves, which are scabrous on both sides, narrower and more erect spikes, and rarely awned flowering glumes.

FIG. 593. **AGROPYRON TENERUM** Vasey, Bot. Gaz. **10**: 258. 1885. SLENDER WHEAT-GRASS.—An erect, caespitose, rather stout, smooth perennial 6–9 dm. (2°–3°) high, with narrow, flat leaves and slender, cylindrical spikes 8–15 cm. (3′–6′) long. Sheaths striate, glabrous; leaf blades 7–15 cm. (3′–6′) long, 2–6 mm. (1″–3″) wide, scabrous. Outer glumes (*a*) **5-nerved; flowering glumes** (*b*) lanceolate, 8–10 mm. (4″–5″) long, tipped with a stiff, straight awn 1–4 mm. (½″–2″) long.—Dry soil, New Mexico and southern California to Washington and British Columbia, and eastward to Minnesota. July, August.

Var. CILIATUM S. & S., U. S. Dept. Agr. Div. Agros. Bul. **4**: 30. 1897, has the sheaths pubescent or the lower ones densely hairy.—Minnesota to Utah.

Var. LONGIFOLIUM S. & S., l. c., has shining, rigid culms and attenuate-pointed, involute leaves, nearly as long as the culm.—California to British Columbia.

FIG. 594. **AGROPYRON OCCIDENTALE** Scribn. U. S. Dept. Agr. Div. Agros. Cir. **27**: 9. 1900. (*A. glaucum occidentale* Scribn. Trans. Kans. Acad. Sci. **9**: 119. 1885; *A. spicatum* S. & S. U.S. Dept. Agr. Div. Agros. Bul. **4**: 33. 1897. Not *Festuca spicata* Pursh, 1814; *Agropyron smithii* Ryd. Mem. N. Y. Bot. Gard. **1**: 60. 1900.) COLORADO BLUE-STEM.—A rigid, upright, glaucous perennial 3–12 dm. (1°–4°) high, from creeping rootstocks, with rather firm, bluish-green leaves and straight, beardless spikes 6–14 cm. ($1\frac{1}{4}'$–$5\frac{1}{2}'$) long. Spikelets 7- to 13-flowered, 12–20 mm. (6″–10″) long, with lanceolate, acuminate-pointed empty glumes (*a*) and acute flowering glumes 8–12 mm. (4″–6″) long.—Dry or moist soil, Wisconsin to Iowa, and westward to Washington, Texas, and Arizona. June to September.

Var. PALMERI Scribn. l. c. (*A. spicatum palmeri* S. & S.) has more robust culms which are clothed at the base with papery leaf-sheaths, the whole plant more or less strigose-pubescent.—Arizona, New Mexico.

Var. MOLLE Scribn. l. c. (*A. spicatum molle* S. & S.) is like the type, but the empty and flowering glumes and rachis are more or less villose-pubescent.

FIG. 595. **AGROPYRON RIPARIUM** Scribn. & Smith, U. S. Dept. Agr. Div. Agros. Bul. **4**: 35. 1897. RIVER-SIDE WHEAT-GRASS.—A rather slender, tufted, glaucous perennial 4.5–6 dm. (1½°–2°) high, with narrowly involute leaves and densely flowered spikes 5–8 cm. (2′–3′) long. Sheaths striate, much shorter than the internodes, the upper glabrous, the lower minutely pubescent; leaf-blades 5–15 cm. (2′–6′) long, 4 mm. (2″) wide or less, scabrous throughout. Spikelets 5- to 7- flowered, 10–12 mm. (5″–6″) long, awnless; empty glumes (*a*) less than one-half as long as the spikelet, acute, 3-nerved, 4 mm. (2″) long; flowering glumes (*b*) acute, glaucous, scabrous above.—River banks, Montana. July, August.

FIG. 596. **AGROPYRON LANCEOLATUM** Scribn. & Smith, U. S. Dept. Agr. Div. Agros. Bul. **4**: 34. **1897**. (***Triticum junceum*** **Hook. Fl. Bor. Am. 2**: 254. 1840. Not Linn.)—A rather stout, yellowish-green or glaucous perennial 6–9 dm. (2°–3°) high, with long, flat leaves and erect or flexuous spikes of large, subcompressed, acute, 4- to 7-flowered spikelets 10–20 mm. (5″–10″) long. Sheaths somewhat inflated, shorter than the internodes, the lower finely pubescent, the upper smooth, leaf blades 15–30 cm. (6′–12′) long, about 4 mm. (2″) wide, scabrous above and on the margins. Empty glumes (*a*) abruptly acuminate 6–9 mm. (3″–4½″) long; flowering glumes (*b*) broadly lanceolate, 8–14 mm. (4″–7″) long, rounded on the back, more or less pubescent, 3-nerved, and scabrous toward the apex.—Idaho to Oregon and Washington. May to July.

Related to *Agropyron occidentale* but readily distinguished by its short, acute empty glumes, lanceolate, acute spikelets, and less crowded spikes.

FIG. 597. **AGROPYRON RICHARDSONI** Schrad. Linnaea, **12**: 467. 1838. (*Triticum richardsoni* Trin. Schrad. l. c.) RICHARDSON'S WHEAT-GRASS.—An erect, smooth perennial 6–8 dm. ($2°–2\frac{2}{3}°$) high, with rather rough, involute pointed leaves and erect, usually one-sided, bearded spikes 7–10 cm. (3′–4′) long. Sheaths open above, smooth, shorter than the internodes: leaf-blades 8–20 cm. (3′–8′) long, 2–6 mm. (1″–3″) wide. Spikelets 3- to 4- flowered; empty glumes (*a*) longer than the spikelets, prominently nerved, 12–16 mm. (6″–8″) long; flowering glumes (*b*) 10–13 mm. ($5''–6\frac{1}{2}''$) long, seabrous on the margins and at the apex, with a scabrous, often purplish awn about 24 mm. (12″) long, arising from the bidentate apex. Dry soil, Nebraska and Minnesota to the Saskatchewan, and south to Colorado. June to September.

Var. CILIATUM S. & S. U.S. Dept. Agr. Div. Agros. Bul. **4**: 29. 1897. Sheaths and leaf-blades pilose-pubescent. Montana.

FIG. 598. **AGROPYRON VASEYI** Scribn. & Smith, U. S. Dept. Agr. Div. Agros. Bul. **4**: 27. 1897. VASEY'S BUNCH-GRASS.—A slender, wiry, erect, dense, caespitose perennial 3–4.5 dm. (1°–1½°) high, with short, involute, setaceous leaves and few-flowered, interrupted spikes 4–8 cm. (1½′–3′) long. Sheaths striate, glaucous, shorter than the internodes; ligule minute; leaf-blades smooth and glaucous on the back, minutely strigose-pubescent above, 2–15 cm. (1′–6′) long, 2 mm. (1″) or less in width. Spikelets rather remote, 3- to 5-flowered, 8–10 mm. (4″–5″) long; empty glumes (*a*) awnless, slightly unequal, scarious on the margins, 6–8 mm. (3″–4″) long; flowering glumes with a divergent awn 8–10 mm. (4″–5″) long.—Dry, gravelly soil, Montana and Nevada to Oregon and Washington. May to August.

Distinguished from *Agropyron spicatum* (Pursh) Ryd., by its shorter, narrower leaves, rigid, more wiry culms, and fewer, smaller spikelets.

FIG. 599 **AGROPYRON SPICATUM** (Pursh) Ryd. Mem. N. Y. Bot. Gard. 1: 61. 1900. (*Festuca spicata* Pursh Fl. Am. Sept. 1: 83. 1814; *Agropyron divergens* Nees in Steud. Syn. Pl. Gram. 347. 1854; *Triticum divergens* Nees l. c.) WIRE BUNCH-GRASS.—A rigid and often wiry, densely tufted perennial 3–9 dm. (1°–3°) high, with narrow, flat, or involute leaves and terminal, usually erect spikes 8–20 cm. (3′–8′) long. Spikelets rather distant, 3- to 6- flowered, with rigid and usually acute empty glumes (*a*) about one-half as long as the spikelet; flowering glumes (*b*) 8–10 mm. (4″–5″) long, smooth and rounded on the back below, scabrous above, terminating in a stout, scabrous, divergent, or flexuous awn 12–24 mm. (6″–12″) long.—Dry, rocky soil and bench lands, Washington and Oregon to Montana, Colorado, and Nevada. June to August.

One of the most valuable bunch grasses of Oregon and Washington.

Var. INERME (S. & S.) Heller, Cat. N. Am. Pl. ed. 2, 3. 1900, is a more slender and densely cæspitose form, with setaceous leaves and muticous or short-awned flowering glumes.

Var. TENUISPICUM (S. & S.) Ryd. Mem. N. Y. Bot. Gard. 1: 61. 1900, has slender, flexuous spikes and from 8 to 14, 3- to 5- flowered spikelets, which are 10–14 mm. (5″–7″) long.

FIG. 600. **AGROPYRON ARIZONICUM** Scribn. & Smith, U. S. Dept. Agr. Div. Agros. Bul. **4** : 27. 1897. ARIZONA WHEAT-GRASS.—A glaucous, erect perennial 4.5–6 dm. ($1\frac{1}{2}°$–$2°$) high, with soft, flat leaves 15–18 cm. (6′–7′) long, nodding spikes 12–22 cm. (5′–9′) long, and rather remote, 5- to 7- flowered spikelets 18–24 mm. (9″–12″) long. Sheaths longer than the internodes, sparsely hairy; leaf-blades 15–23 cm. (6′–9′) long, 6 mm. (3″) wide or less, smooth below, seabrous on the margins, strigose-pubescent above, those of the innovations longer. Empty glumes (*a*) about one-half as long as the spikelet; flowering glumes (*b*) 10–14 mm. (5″–7″) long, seabrous, tipped with a stout, seabrous, divergent awn about 24 mm. (12″) long.—Mountains, New Mexico and Arizona. **(Mexico.) August, September.**

FIG. 601. **AGROPYRON GMELINI** Scribn. & Smith, U. S. Dept. Agr. Div. Agros. Bul. **4**: 30. 1897. SHORT-LEAFED WHEAT-GRASS.—A rather slender, erect, glabrous, cæspitose perennial 6–12 dm. (2°–4°) high, with flat leaves and slender spikes 8–20 cm. (3′–8′) long. Sheaths longer than the internodes, glabrous: leaf-blades glabrous below, scabrous above, the basal ones 2–8 cm. (1′–3′) long, 4–6 mm. (2″–3″) wide, those of the culm much longer. Spikelets 7- to 9-flowered, 12–18 mm. (6″–9″) long; empty glumes (*a*) unequal, short-awned, two-thirds as long as the spikelet; flowering glumes (*b*) 10–12 mm. (5″–6″) long, acuminate, awned from, or just below the apex with a slender, divergent, scabrous awn 16–30 mm. (8″–15″) long.—Moist soil, mountains, Washington to western Nebraska.

Var. PRINGLEI S. & S. l. c. 31, is a low, tufted form with short rigid leaves, which are glaucous below, strigose above, and loose, few-flowered spikes.—High mountains, Wyoming and California.

FIG. 602. **SECALE MONTANUM** Guss. Fl. Sic. Prod. 1 : 145. 1827. MOUNTAIN RYE.—A fibrous-rooted, erect, glabrous perennial 9–12 dm. (3°–4°) high, with flat leaves and nodding, somewhat compressed spikes 6–10 cm. (2¼′–4′) long. Sheaths striate, glabrous, slightly shorter than the internodes; leaf-blades 15–30 cm. (6′–12′) long, 5–10 mm. (2½″–5″) wide, glabrous except on the scabrous margins, alternate. Spikelets (*a*) about 15 mm. (7½″) long, with very narrow, awnless, or short-awned empty glumes and ciliate, 5-nerved, awned flowering glumes; awns 28–30 mm. (14″–15″) long. A flower is shown by *b* and the lodicules by *c*.—Sparingly introduced into cultivation. July.

Probably a good hay grass.

FIG. 603. **HORDEUM JUBATUM** Linn. Sp. Pl. 85. 1753. SQUIRREL-TAIL GRASS.—A smoöth, slender, and erect perennial (?) 2–6 dm. ($\frac{2}{3}$°–2°) high, with flat leaves and long-bearded nodding spikes 5–10 cm. (2′–4′) long. Sheaths usually shorter than the internodes, loose, glabrous; leaf-blades 2–12 cm. (1′–5′) long, scabrous. Spikelets (*a*) usually in threes, the lateral ones imperfect: empty glumes awn-like, 3–5 cm. (1¼′–2′) long. The flowering glume of the central spikelet 6–8 mm. (3″–4″) long, terminating in a slender awn 3–5 cm. (1¼′–2′) long.—Moist saline soils, Canada, the United States south to Kansas, Colorado, and California; Alaska. May to August.

This species has no agricultural value, and in many sections is classed as a bad weed. Hay containing this grass is considered nearly valueless; cases having been reported where the beards or awns have caused the death of cattle and horses.

FIG. 604. **HORDEUM MARITIMUM** With. Bot. Arr. Br. Pl. 172. 1776. SEA-SIDE BARLEY.—A smooth, upright or spreading, caespitose annual 1–3 dm. (4′–12′) high, with short leaves and terminal, bearded spikes 2–4 cm. (¾′–1¼′) long. Sheaths about as long as the internodes, the upper one inflated; leaf-blades 2–6 cm. (1′–1½′) long, mostly involute. Spikelets (*a*), including the rigid, spreading awns, 10–12 mm. (5″–6″) long, the outer glumes not ciliate.—Sandy soil along the coast, British Columbia to southern California. (Naturalized **from Europe.) May to July.**

This species is distinguished from *H. nodosum* by the broadened inner empty glume of the lateral spikelets, which are sometimes staminate and distinctly awned.

FIG. 605. **HORDEUM MURINUM** Linn. Sp. Pl. 85. 1753. WALL BARLEY.—A rather stout, cæspitose annual 3–6 dm. (1°–2°) high, with short, flat leaves, inflated sheaths, and compressed spikes 5–10 cm. (2′–4′) long. Sheaths loose, shorter than the internodes or sometimes exceeding them, the upper one often inflated and inclosing the base of the spike. Spikelets, including the awns, 4 cm. (1½′) long, the glumes of the middle spikelet lanceolate and conspicuously ciliate on the margins, bearing awns 18–24 mm. (9″–12″) long, those of the lateral spikelets similar, with the exception of the second glume, which is not awned.—On ballast, New York, New Jersey, and Delaware, and along the Pacific coast from British Columbia to southern California. (Europe.) April to July.

This species is at once distinguished by the ciliate, flattened, empty glumes of the central spikelets of each cluster and the ciliate inner glumes of the lateral spikelets.

FIG. 606. **HORDEUM GUSSONIANUM** Parl. Fl. Palerm. in obs. 244. 1845.—A slender, cæspitose, erect or ascending annual 1–3 dm. (4′–12′) high, with short leaves and spikes. Sheaths shorter than the internodes, smooth, the upper ones loose; leaf-blades 2–4 cm. (¾′–1½′) long, 1–3 mm. (½″–1½″) wide, smooth, plane. Empty glumes subulate, long-awned, the inner pair distinctly flattened.—California and Oregon, introduced. (Europe.) May, June.

Resembling *H. maritimum* in habit but distinguished from that species by its having the inner empty glumes narrowly flattened instead of wing-margined along the inner side.

FIG. 607. **HORDEUM ADSCENDENS** H. B. K. Nov. Gen. et Sp. Pl. **1**: 180. 1815.—A rather slender, erect, leafy annual (?) 6–9 dm. (2°–3°) high, with pubescent lower sheaths, flat and rather rigid leaves, and bearded, terminal spikes 6–8 cm. (2½′–3′) long. Sheaths shorter than the internodes, the lower ones densely pubescent, the upper smooth; leaf-blades rigid, 8–16 cm. (3′–6′) long, 4–6 mm. (2″–3″) wide, scabrous. Empty glumes setaceous, rounded on the back, grooved on the inner face below; those of the central spikelet about 2 cm. (¾′) long; flowering glume of the central spikelet 9–10 mm. (4½″–5″) long, with an awn 20–24 mm. (10″–12″) long. Lateral spikelets neutral.—Along irrigating ditches, Arizona. (Mexico.) April to June.

Distinguished from *H. nodosum* by its taller habit of growth, attenuate, pungent-pointed leaves, longer spikes and awns, and flattened or sulcate, not terete, empty glumes.

FIG. 608. **HORDEUM MONTANENSE** Scribn. in Beal, Grasses N. A. **2**: 641. 1896. MONTANA BARLEY.—An erect, leafy biennial or perennial 6-9 dm. (2°-3°) high, with smooth culms, scabrous leaves, and bearded spikes 4-6 cm. (1½′-2½′) long. Culms smooth and shining; sheaths shorter than the internodes, smooth, or the lower ones sparingly pubescent; leaf-blades 5-10 cm. (2′-4′) long, **4-6 mm. (2″-3″) wide, acuminate-pointed. Empty glumes** linear-lanceolate, **12-20 mm. (6″-10″) long, including the slender, scabrous** awns. The central **spikelet of each group usually 2-flowered; first** flowering glume about 10 mm. (5″) long, awned; awn 16-18 mm. (8″-9″) long. Lateral **spikelets** 2-flowered; **florets nearly sessile.—Moist thickets, Montana.**

At once distinguished from *H. boreale* by having the lateral **spikelets nearly sessile**, and the first floret of the central spikelet raised **upon a short stipe.**

FIG. 609. **HORDEUM NODOSUM** Linn. Sp. Pl. ed. 2, 126. 1762. WILD or MEADOW BARLEY.—A slender, erect, cæspitose perennial 2–6 dm. (⅔°-2°) high, with flat, scabrous leaves and narrow, bearded spikes 2–8 cm. (1′-3′) long. Sheaths shorter than the internodes; leaf-blades 4–12 cm. (1¼′-5′) long, 2–6 mm. (1″-3″) wide. Empty glumes setaceous or awn-like from the base; lateral spikelets imperfect; awns 6-12 mm. (3″-6″) long.—Thin, dry soils, Indiana and Minnesota to Alaska, and south to Tennessee, Mississippi, Texas, and California. May to August.

Similar in habit to *H. pusillum* but usually more erect and taller, and with the empty glumes not at all flattened or dilated above the base.

FIG. 610. **HORDEUM PUSILLUM** Nutt. Gen. 1: 87. 1818. LITTLE BARLEY.—A slender, rather rigid, erect, glabrous perennial, 1–3.5 dm. (4′–14′) high, with comparatively short, flat leaves and terminal spikes 2–7 cm. (1′–3′) long. Sheaths smooth, the uppermost often inflated and inclosing the base of the spike; leaf-blades 2–7 cm. (1′–3′) long, usually slightly pubescent beneath. Outer glumes of the central spikelets and lower ones of the lateral spikelets much broadened above the base; those of the central spikelet oblanceolate, all awn-pointed; flowering glume of the central spikelet (*b*) awned, those of the lateral spikelets awnless or nearly so.—Arid, saline or alkaline soils from Ontario to British Columbia, south to South Carolina, Louisiana, and Texas. April to August.

Distinguished from *H. nodosum*, with which it has been confounded, by the dilated inner empty glumes of the lateral spikelets and the lanceolate empty glumes of the central spikelet.

FIG. 611. **ELYMUS STRIATUS** Willd. Sp. Pl. 1: 470. 1797. SLENDER LYME-GRASS.—A rather slender, erect, leafy perennial 6–9 dm. (2°–3°) high, with flat leaves and slender, bearded, somewhat nodding spikes 7–10 cm. (2¾′–4′) long. Sheaths hairy, or the upper ones smooth; leaf-blades 15–20 cm. (6′–8′) long, pubescent on the upper surface, seabrous on the margins. Spikelets 1- to 3-flowered, with awn-shaped, hispid or hirsute empty glumes two to three times the length of the floret, and seabrous, slender-awned flowering glumes about 6 mm. (3″) long; awns 16–30 mm. (8″–15″) long.—Woods and river banks, Maine to South Dakota and south to New Jersey, Tennessee, Arkansas, and Texas. June to August.

FIG. 612. **ELYMUS VIRGINICUS** Linn. Sp. Pl. 84. 1753. TERRELL GRASS.—A rather stout, leafy, erect, glabrous perennial 6–10.5 dm. (2°–3½°) high, with terminal, erect spikes 4–14 cm. (1½′–5½′) long, the bases of which are usually inclosed in the inflated uppermost sheath. Sheaths striate, smooth or hairy; leaf-blades 15–30 cm. (6′–12′) long, 4–8 mm. (2″–4″) wide, acute, scabrous. Spikelets with thick and rigid, lanceolate empty glumes 16–24 mm. (8″–12″) long (including the short awn); flowering glumes lanceolate, rounded on the back, smooth, rarely sparingly scabrous, bearing a scabrous awn 4–18 mm. (2″–9″) long, rarely awnless.—Moist soil, borders of thickets and open woodlands, Nova Scotia and New Brunswick to Florida, and westward to Manitoba and Texas. June to September.

FIG. 613. **ELYMUS ROBUSTUS** Scribn. & Smith, U. S. Dept. Agr. Div. Agros. Bul. **4**: 37. 1897. GREAT LYME-GRASS.—A stout, leafy perennial 9–18 dm. (3°–6°) high, with thick, terminal, long-bearded spikes 12–18 cm. (5′–7′) long. Culms smooth, shining. Sheaths glabrous or minutely scabrous, exceeding the internodes; leaf-blades constricted at the base, 23–38 cm. (9′–15′) long, 8–20 mm. (4″–10″) wide, strongly scabrous throughout. Spikelets 3- to 4- flowered, with linear-subulate empty glumes (*a*) and scabrous or pubescent flowering glumes (*b*), which are 5-nerved above the middle, bifid at the apex, and awned from between the setaceous teeth; awns spreading 3–4 cm. (1¼′–1¾′) long.—Rich, moist soil. Illinois and Montana to Kansas and New Mexico. June to September.

Distinguished from *Elymus canadensis* by its larger, more robust spikes, and longer, stouter awns.

FIG. 614. **ELYMUS MACOUNII** Vasey, Bul. Torr. Bot. Club, **13** : 119. 1886.
MACOUN'S LYME-GRASS.—A slender, upright, smooth, cæspitose perennial 3–8 dm. (1°–2⅔°) high, with narrow, erect leaves and slender, nearly cylindrical spikes 6–10 cm. (2½′–4′) long. Sheaths glabrous or the lower ones pilose: leaf-blades 8–16 cm. (3′–6′) long, 4 mm. (2″) wide or less, scabrous, the lower ones usually pilose at least on the upper surface. Spikelets 1- to 3- flowered: empty glumes (*a*) 2 (or sometimes 3), linear-lanceolate, usually 3-nerved, 6–8 mm. (3″–4″) long, scabrous, awned, the awn often as long as the glume; flowering glumes (*b*) 8–10 mm. (4″–5″) long, 5-nerved, bearing a slender awn which equals or exceeds the glume in length.—**Rather moist soil, South Dakota to Colorado and Montana; British Columbia. June to August.**

FIG. 615. **ELYMUS SALINUS** Jones, Proc. Cal. Acad. Sci. II, **5**: 725. 1895. ALKALI LYME-GRASS.—A rigid, wiry, erect, densely cæspitose perennial 3–6 dm. (1°–2°) high, with rather rigid, involute, spreading leaves and narrow, erect spikes 5–10 cm. (2′–4′) long. Sheaths shorter than the internodes, nearly smooth, the lower ones loose; leaf-blades 10–15 cm. (4′–6′) long, pubescent beneath, linear, involute. Spikelets usually single at each joint, about 12 mm. (6″) long, and 5- to 9- flowered; empty glumes (*a*) nearly subulate, unequal, about 4 mm. (2″) long; flowering glumes (*b*) short-awned, about 8 mm. (4″) long, indistinctly 5-nerved, smooth and rounded, with a narrow, hyaline, lacerate margin.—Alkali soil, Utah and Wyoming. June to August.

FIG. 616. **ELYMUS SIMPLEX** Scribn. & Williams, U. S. Dept. Agr. Div. Agros. Bul. **11**: 57. *pl. 17.* 1898. SALT LYME-GRASS.—A wiry, erect perennial 3–4 dm. (12′–16′) high, from strong, creeping rootstocks, with flat (finally involute) pungently-pointed, rigid leaves and densely-flowered, erect spikes 5–8 cm. (2′–3¼′) long. Lower sheaths crowded, exceeding the internodes, glabrous; leaf-blades 4–10 cm. (1½′–4′) long, 3–6 mm. (1½″–3″) wide. **Spikelets** solitary or in pairs, 5- to 7- flowered, about 15 mm. (7½″) long, with very rigid and subulate-pointed empty glumes (*a*) and smooth flowering glumes (*b*), which are about 7 mm. (3½″) long, with rigid awns 5–6 mm. (2½″–3″) long.—Borders of ponds. **Wyoming. July, August.**

Var. LUXURIANS S. & W. l. c. 58, is glaucous throughout, with stouter culms, longer and broader leaves, and narrower panicles, which are often branched, and with spikelets 10- to 12- flowered.

FIG. 617. **ELYMUS CONDENSATUS** Presl, Rel. Haenk. 1: 265. 1830. GIANT RYE-GRASS.—A stout, erect perennial 9–24 dm. (3°–8°) high, often growing in great clumps or bunches, with long, rather rigid, flat leaves and dense spikes 10–30 cm. (4′–12′) long. Sheaths smooth; leaf-blades 1.5–9 dm. (½°–3°) long, 6–24 mm. (3″–12″) wide, smooth or scabrous. Spikelets 3- to 6- flowered, with subulate empty glumes (*a*) and mucronate-pointed flowering glumes (*b*) 8–10 mm. (4″–5″) long, minutely scabrous-pubescent, rarely nearly smooth, often 3-toothed at the apex.—Usually moist and alkaline soils, Nebraska and the Dakotas to Washington and Oregon, south to Arizona and California. June to September.

Var. PUBENS Piper, Eryth. 7: 101. 1900, is a smaller form, with pubescent culms, especially near the nodes, villouse-pubescent sheaths and minutely pubescent inflorescence. Washington.

FIG. 618. **ELYMUS FLAVESCENS** Scribn. & Smith, U. S. Dept. Agr. Div. Agros. Bul. 8: 8, *f. 1.* 1897. YELLOW LYME-GRASS.—A stout, erect perennial 6–10.5 dm. (2°–3½°) high, from long, creeping rootstocks, with long somewhat rigid leaves and rather loosely flowered yellowish spikes 10–20 cm. (4′–8′) long. Sheaths striate, glabrous, often glaucous, the lower ones becoming loose and fibrous; leaf-blades 20–40 cm. (8′–16′) long, 8–16 mm. (4″–8″) wide, smooth below, strongly scabrous or strigose-pubescent above. Spikelets 3- to 6- flowered, 10–20 mm. (5″–10″) long, densely villous, with long whitish or yellow hairs. Glumes awnless, the outer ones very unequal and glabrous.—Dry sandy soil, Idaho to Oregon and Washington. May, June.

Apparently a good sand binder for the dry regions of the interior.

FIG. 619. **ELYMUS INNOVATUS** Beal, Grasses of N. A. **2** : 650. 1896. (*Elymus brownei* Scribn. & Smith, U. S. Dept. Agr. Div. Agros. Bul. **8** : 7, *pl. 4*. 1897: *Elymus mollis* R. Br. in Richardson, Franklin Narr. First Voy. 732. 1823. Not Trin. 1821.) BROWN'S WILD RYE.—A rigid, rather slender, erect perennial 5–9 dm. ($1\frac{2}{3}°$–$3°$) high, with short cauline leaves, and densely flowered, pubescent spikes 4–10 cm. ($1\frac{1}{2}'$–$4'$) long. Sheaths striate, smooth; leaf-blades rather rigid, those of the innovations erect, 10–18 cm. ($4'$–$7'$) long, 2–5 mm. ($1''$–$2\frac{1}{2}''$) wide, those of the culm somewhat shorter. Spikelets 3- to 6- flowered, 10–15 mm. ($5''$–$7\frac{1}{2}''$) long; empty glumes (*a*) scabrous or minutely pubescent: flowering glumes (*b*) 8–10 mm. ($4''$–$5''$) long, rounded on the back, densely pubescent or subvillous, short awn-pointed.—Gravelly or sandy banks, South Dakota, Wyoming, British Columbia, and northward to Alaska. June to September.

Fig. 620. **ELYMUS HIRSUTIGLUMIS** Scribn. U. S. Dept. Agr. Div. Agros. Bul. **11**: 58. 1898. (*E. intermedius* Scribn. & Smith, ibid. **4**: 38. 1897, not *E. intermedius* Bieb. Fl. Taur. Cauc. **1**: 82. 1808.) HAIRY-FLOWERED LYME-GRASS.—A rather stout, erect, leafy perennial 6–9 dm. (2°–3°) high, with smooth culms and sheaths and erect, slender spikes 5–8 cm. (1¼′–3′) long. Sheaths glabrous, exceeding the internodes; leaf-blades, erect, linear, scabrous, 10–18 cm. (4′–7′) long, 4–6 mm. (2″–3″) wide, attenuate to the filiform or acuminate apex. **Spikelets mostly in twos, rarely in threes;** empty glumes linear, 3- to 5-nerved above, 10 mm. (5″) long, 2–3 mm. (1″–1½″) broad, hirsute, tipped with a scabrous awn; **flowering glume on a short stipe, 5-nerved,** hirsute-pubescent, 8–9 mm. (4″–4½″) long; awn 14–16 mm. (7″–8″) long, slender, scabrous.—Maine to Virginia **and westward to Illinois and Nebraska.** July, August.

FIG. 621. **ELYMUS DASYSTACHYS LITTORALIS** (Pall.) Griseb. in Ledeb. Fl. Ross. **4** : 333. 1853. (*Triticum littorale* Pall. Reise **3** : 287. 1776.)—A stout, erect perennial 8–10 dm. ($2\frac{2}{3}$°–$3\frac{1}{3}$°) high, from strong, creeping rootstocks, with long, **sharp-pointed leaves,** and loosely-flowered, often branched spikes 20–30 cm. (8′–12′) long. Sheaths, excepting the lower ones, **strongly striate, glabrous;** leaf-blades 20–40 cm. (8′–16′) long, 3–5 mm. ($1\frac{1}{4}$″–$2\frac{1}{2}$″) wide, glabrous beneath, strongly strigose-pubescent above. Spikelets 5- to 9- flowered, with rigid, narrowly lanceolate, empty glumes (*a*) and acute flowering glumes (*b*), which are 12–14 mm. (6″–7″) long, and pubescent on the back, excepting near the apex.—Washington and Idaho. August.

FIG. 622. **ELYMUS VILLOSISSIMUS** Scribn. U. S. Dept. Agr. Div. Agros. Bul. **17**: 326, *f. 622.* 1899. NORTHERN LYME-GRASS.—A stout, erect perennial 3–4 dm. (12′–16′) high, from a strong, creeping rootstock, with rather broad, comparatively short, flat leaves, and short, densely flowered panicles 5–8 cm. (12′–16′) long. Sheaths striate, loose, glabrous, the lower ones crowded, the upper one elongated; leaf-blades 5–15 cm. (2′–6′) long, 5–10 mm. (2¼″–5″) wide. Spikelets (*a*) 3- to 5-flowered, about 15 cm. (6′) long, with densely villous or lanate glumes, the outer ones narrowly lanceolate and subulate-pointed, nearly equaling the spikelet. Ligule nearly obsolete.—Uplands, St. Paul Island, Bering Sea; also Wrangell Island, Arctic America.

Type specimen from St. Paul Island, James M. Macoun (16226). July. August.

FIG. 623. **ELYMUS SAUNDERSII** Vasey, Bul. Torr. Bot. Club, **11**: 126. 1884.
SAUNDERS LYME-GRASS.—A slender, tufted, erect perennial 6–10.5 dm. (2°–3½°) high, with narrow, rather rigid leaves and long-bearded spikes, 10–14 cm. (4′–5½′) long. Sheaths smooth, the upper one elongated; radical leaves involute-setaceous, about one-half as long as the culm. Spikelets 2- to 4- flowered; empty glumes (*a*) linear-lanceolate; awns 40–50 mm. (20″–25″) long; flowering glume (*b*) 2-toothed at the apex, 3- to 5- nerved, about 10 mm. (5″) long, exclusive of the awn, which is 3 cm. (1¼′) or more in length.—Veta Pass, Colorado.

Axis of the spike readily breaking up as in *Sitanion*.

FIG. 621. **SITANION HANSENI** (Scribn.) J. G. Smith, U. S. Dept. Agr. Div. Agros. Bul. **18**: 20. June 24. 1899. (*Elymus hanseni* Scribn. U. S. Dept. Agr. Div. Agros. Bul. **11**: 56. *f. 12.* 1898.) HANSENS SITANION.—A rather stout glabrous perennial 9-12 dm. (3°-4°) **high, with narrow, spreading leaves and** slender, fragile spikes 5-8 cm. (2′-3¼′) long. Sheaths smooth, striate; leaves 10-30 cm. (4′-12′) long. Spikelets 3- to 5-flowered, about 15 mm. (7½″) long exclusive of the awns, which are 2-5 cm. (¾′-2′) long; empty glumes (*a*) tipped with 2 (or sometimes 3) unequal **awns**, the longer ones often 3.5 cm. (1⅓′) long; flowering glumes (*b*) 10-12 mm. (5″-6″) long, entire or 2-toothed at the apex, terminating in a straight, very slender awn, about 5 cm. (2′) long.—Dry, open grounds, Amador County, California.

Related to *S. anomalum*, but taller and more slender, with mostly single, longer and more remote spikelets.

FIG. 625. **SITANION GLABRUM** J. G. Smith, U. S. Dept. Agr. Div. Agros. Bul. **18**: 14. June 24, 1899. ORCHARD BARLEY.—A rather stout, erect, densely caespitose perennial, 3–5 dm. (1°–1⅔°) high with the sheaths and under side of the leaves glabrous, the long-bearded spikes 5–8 cm. (2′–3¼′) long. Sheaths shorter than the internodes; leaf blades 7–15 cm. (3′–6′) long; 2–5 mm. (1″–2½″) wide, flat or becoming involute, scabrous-pubescent along the nerves above. Empty glumes bifid to the very base, the divisions subulate-setaceous, 6–8 cm. (2¼′–3′) long, divaricate; flowering glumes (*b*) 7–8 mm. (3½″–4″) long, smooth and shining below, entire or minutely bifid at the apex, tipped with a slender setaceous awn 4–5 cm. (1½′–2′) long.—California to Washington.

FIG. 626. **ASPERELLA CALIFORNICA** (Boland.) Beal, Grasses N. A. **2**: 657. 1896. (*Gymnostichum californicum* Boland. Cat. 35. 1870.) CALIFORNIA BOTTLE-BRUSH.—A stout, erect perennial 10–20 dm. (3°–7°) high, with hirsute lower sheaths, broad, flat leaves, and terminal, bearded spikes 15–25 cm. (6′–10′) long. Sheaths, at least the lower ones, clothed with short, stiff, spreading hairs; leaf-blades scabrous, 10–25 mm. (5″–12½″) wide. Spikelets 1- to 3- flowered, with nearly obsolete empty glumes and strongly hispid flowering glumes (*a*) which are 5- to 6- nerved above, 12 mm. (6″) long, terminating in a stout, rough awn nearly as long as the glume itself.—California.

FIG. 627. **ARUNDINARIA MACROSPERMA** Michx. Fl. Bor. Am. 1: 74. 1803. CANE.—A stout, woody, almost arborescent grass 45–90 dm. (15°–30°) high, with lanceolate leaves and lateral panicles composed of a few simple racemes. Spikelets 25–45 mm. (12″–24″) long, 5- to 9- flowered; empty glumes unequal, the first 5 mm. (2½″) long, 7-nerved, the second 10 mm. (5″) long, 11-nerved; flowering glumes (*a*) short-pointed, many-nerved, ciliate on the margins. Palea (*b*) equaling the glume, 2-toothed. The grain is shown by *c*.—In rich wet soil, river banks, etc. Virginia to Florida, and westward to Texas.

This species forms the well-known canebrakes of the South. It blooms but once, and when the seeds mature the plant dies. The canes are used for many purposes, such as fishing rods, splints for baskets, mats, etc. It can not be cultivated successfully.

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BULLETIN No. 18. Agros. 46.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF AGROSTOLOGY.

[Grass and Forage Plant Investigations.]

STUDIES ON AMERICAN GRASSES.

A SYNOPSIS OF THE GENUS SITANION.

BY

JARED G. SMITH.

PREPARED UNDER THE DIRECTION OF F. LAMSON-SCRIBNER, AGROSTOLOGIST.

ISSUED JUNE 24, 1899.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF AGROSTOLOGY,
Washington, D. C., May 3, 1899.

SIR: I have the honor to transmit herewith the manuscript of a paper entitled "Synopsis of the genus *Sitanion*," prepared under my direction by Mr. Jared G. Smith, assistant agrostologist, and recommend the same for publication as Bulletin No. 18 of this division under the general title of "Studies on American Grasses."

Respectfully,

F. LAMSON-SCRIBNER,
Agrostologist.

Hon. JAMES WILSON,
Secretary of Agriculture.

INTRODUCTION.

The many and striking differences presented by the specimens which have been referred to *Sitanion hystrix* (*Elymus sitanion*) have long been recognized, but no one has heretofore attempted to define or classify them. From the material in the herbarium of the Academy of Natural Sciences of Philadelphia, it is evident that Nuttall distinguished at least two species. These are shown in Plate I, the tickets attached to the specimens being in Nuttall's handwriting. The large amount of material in the National Herbarium, gathered from numerous and widely separated localities by many collectors, has afforded an excellent opportunity for a study of the variations which with the increase of the collection became more and more apparent, and the necessity of their classification more and more evident. The present paper, prepared by my direction, was undertaken to meet this necessity, and while the species here defined may require some modification after further studies in the field, and while some classed as species may eventually be reduced to varieties, the subject as presented can hardly fail to be of interest to the student of grasses and helpful in the close discrimination of the species of a critical group of plants.

Nuttall,[1] who first described the species of this genus, referred it to the European *Ægilops* and named his plant *Ægilops hystrix*. His description was carefully drawn up and his species can be readily recognized. A year later, Rafinesque[2] published his genus *Sitanion*, based upon a single species, which he named *Sitanion elymoides*. It has been found impossible to determine with certainty which of the species enumerated in the present paper was the one named by Rafinesque; it certainly was not, however, the grass described by Nuttall.

Our leading authorities, Bentham and Hooker,[3] Hackel,[4] and Baillon,[5] have all reduced *Sitanion* to a section of *Elymus*. The articulate rachis, readily breaking up at maturity, and the usually bifid or many parted and awned empty glumes are well-defined characters, distinguishing the species from *Elymus*, and justifying their separation as a distinct

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[1] Genera North American Plants, **1**: 86. 1818.

[2] Journ. Phys., **89**: 103. 1819.

[3] Genera Plantarum **3**: p. 1207.

[4] Die Natürlichen Pflanzenfamilien **2**: part 2, p. 88.

[5] Histoire des Plantes, Monographie des Graminées, 258.

genus. To be sure there are species so closely connecting *Elymus* with *Sitanion* that it is difficult to determine to which genus they ought to be referred, but the same is true in the case of *Elymus* and *Agropyron;* there are intermediates which may with equal propriety be placed either in the one genus or the other.

That there are forms connecting *Sitanion* with *Elymus* indicates their close relationship, but this fact does not afford sufficient reason for uniting them, and the paper here presented, describing the many species into which *Sitanion* may be divided, affords good evidence and ample justification for its separation.

F. LAMSON-SCRIBNER.

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A SYNOPSIS OF THE GENUS SITANION.

CHARACTERS OF THE GENUS.

SITANION Rafinesque, in Journ. Phys., **89**: 103, 1819.
Ægilops Nutt., Gen. N. Am. Pl., **1**: 86, 1818; not Linn. (1737.)
Polyantherix Nees, in Ann. Nat. Hist., Ser. I, **1**: 284, 1838.

Cæspitose perennials with intravaginal innovations. Rhachis of the spike articulating at the nodes; spikelets rarely 1, usually 2, or sometimes 3 at each node, each subtended by 2 persistent empty glumes. Empty glumes all subulate, setaceous and entire; or lanceolate and bifid; or many-parted from near the base; with recurving or spreading, scabrous awns terminating each lobe. Flowering glumes all alike, lanceolate, acute, or that of the lowest floret sterile and resembling the subulate-setaceous long-awned empty glumes; entire or with a single terminal recurving or spreading awn, or trifid and 3-awned. Inflorescence a spike, or very rarely spiciform-paniculate. A genus endemic to western North America, containing 23 species.

NOTE: Sitanion, section *Elymoides*, consists of 4 species intermediate between this genus and *Elymus*. They are placed here tentatively, as being more closely allied to *Sitanion*.

ANALYTICAL KEY TO THE SPECIES.

* Empty glumes many-lobed; lowest floret sterile, subulate-setaceous.
† Culms robust, 6–9 dm. high, spike and florets large; awn of the flowering glume 8–10 cm. long .... 1. *S. jubatum.*
†† Culms 1–5 dm. high; spike and florets medium or small; awn of the flowering glume 2–7 cm. long.
‡ Leaves short, flat, divergent; the blades and sheaths villous.
2. *S. villosum*
‡‡ Leaves long, erect or ascending, involute, strigose or pubescent.
= Awns of the empty and flowering glumes about as long as the axis of the spike.............................. 3. *S. multisetum.*
= = Awns of the empty and flowering glumes shorter than the axis of the spike.
a Leaves of the innovations involute, filiform, pilose.
4. *S. polyantherix.*
b Leaves of the innovations involute, rather rigid, strigose.
5. *S. breviaristatum.*

** Some of the empty glumes 2-nerved, bifid from about the middle, the lobes abruptly divergent; lowest floret of one or both spikelets sterile and like the empty glumes, but inserted on the rhachilla and falling away with it.
† Only one spikelet at each joint with fertile florets.............. 6. *S. minus.*
†† Both spikelets bearing fertile florets.
‡ Sheaths and dorsal surface of leaves glabrous; glaucous.
a Low alpine plants....................................... 7. *S. rigidum.*
b Erect, densely cæspitose .... 9. *S. glabrum.*
c Erect, slender; flowering glume half as long as its awn.
10. *S. insulare.*
d Slender; innovations very numerous............ 13. *S. cæspitosum.*

‡‡ Leaves dorsally pubescent or scabrous.

§ Awn 2 to 3 times as long as the flowering glume. 11. *S. cinereum.*

§§ Awn at least 4 times as long as the flowering glume.

1. Innovations very numerous; culms slender. 12. *S. hystrix.*
2. Innovations few; culms robust.

a Culm leaves 2–8 cm. long; flat, rigid, obtuse, divaricate. 8. *S. californicum.*

b Culm leaves 1–2.5 dm. long, flexuous; flowering glume scabrous.......................... 15. *S. strigosum.*

c Culm leaves short, rigid, ascending, 5–10 cm. long; flowering glume smooth below, scabrous above. 14. *S. montanum.*

d Culm leaves rigid; flowering glume glabrous. 16. *S. molle.*

*** Empty glumes subulate-setaceous, entire; lowest floret hermaphrodite.

a Culm leaves very long, flexuous, filiform-involute........ 18. *S. longifolium.*

b Culm leaves short, rigid, spreading, or horizontally divaricate.

1 Flowering glume 1 cm. long, glaucous; culms robust. 17. *S. brevifolium.*

2 Flowering glume 7 mm. long, soft pubescent; culms low. 19. *S. pubiflorum.*

**** Empty glumes lanceolate, 2–5-nerved, entire or lobed.

† Lowest floret longer than the internodes of the rachis.

‡ Leaves flat, glaucous, more strongly nerved on the back than above, 5–8 mm. wide .... 20. *S. planifolium.*

‡‡ Leaves involute, more prominently nerved above than on the back, 2–3 mm. wide .... 21. *S. lanceolatum.*

†† Internodes of the rachis longer than the lowest floret.

1 One spikelet at each node...................... 22. *S. hanseni.*

2 Two spikelets at each node................ 23. *S. anomalum.*

DESCRIPTION OF THE SPECIES.

§ **Polyantherix.** (Nees, as a genus.) *Lowest flowering glume of one or both spikelets sterile, awnlike: empty glumes deeply cleft into from 3 to 11 or more setaceous awns.*

1. SITANION JUBATUM J. G. Smith, sp. nov.

Culms stout, erect, or ascending, 6 to 9 dm. high, robust, terete, smooth. Nodes glabrous. Lower sheaths hirsute, the upper ones minutely pubescent or when young sparsely hirsute, becoming smooth, much exceeding the internodes, open at the throat. Ligule cartilaginous, 1 mm. long. Blade narrowly linear-lanceolate, 10 to 18 cm. long, 3 to 5 mm. wide, rather rigid, flat at the base, involute toward the acuminate apex, strigose-pubescent throughout, sparsely hirsute above and on the back toward the base, finely nerved above, with the midnerve prominent beneath. Spike 1 to 2 dm. long, often more than 1.5 dm. in diameter to the tips of the spreading awns, densely flowered, exserted or the basal portion inclosed in the uppermost leaf sheath. Empty glumes 4, 3- to many-parted from about the middle, the lobes setaceous, from 1 to 10 cm. long. Spikelets 2 at a node, each 2- to 4-flowered, the lowest sterile, the second hermaphrodite, the uppermost staminate or sterile. Flowering glume linear-lanceolate, acute, 8 to 10 mm. long, smooth and shining below, 5-nerved from about the middle, sparsely scabrous above, trifid at the apex, the lateral lobes setaceous, the middle one prolonged into a slender, scabrous, subflexuous awn, 8 to 12 cm. long. Internodes of the rachis 5 to 7 mm. long, compressed or plano-convex, spatulate, glabrous.

Type collected by Robert M. Horner, No. 573, Waitsburg, Wash., May 27, 1897, distributed as "*Elymus sitanion jubatum.*" Also collected by Frank W. Hubby, No. 48, among rocks, Ojai Valley, California, May 7, 1896.

SITANION VILLOSUM J. G. Smith. Type.

This grass is the largest and most robust species of *Sitanion*. It belongs to the *S. multisetum* group, differing from all other species in the very large spike and exceptionally long awn of the flowering glume.

2. **SITANION VILLOSUM** J. G. Smith, sp. nov. Pl. I.

Culms stout, erect, or slightly geniculate, 2 to 3 dm. high, densely leafy at the base, forming close, matted tufts. Sheaths rather densely hirsute, the lower strict, the uppermost somewhat inflated, scabrous. Ligule almost obsolete. Blades short, rigid, ascending or divaricate, finely strigose-pubescent and more or less densely hirsute, scabrous along the cartilaginous margins, linear-lanceolate, acuminate, pungently-pointed, 4 to 8 cm. long, about 3 mm. wide, flat, or at length involute. Spike 6 to 8 cm. long, subflexuous, its base inclosed in the greatly elongated uppermost leaf-sheath. Empty glume 3- to 7- or 8-parted from near the base, each lobe a very slender, scabrous, divaricate awn from 2.5 to 8 cm. long. Lowest floret usually sterile, its glume many-parted, like the empty glumes. Perfect florets 1 or 2. Flowering glume about 8 mm. long, obliquely lanceolate, smooth and shining at the base, scabrous for the upper two-thirds, 3-awned, the middle awn rather stout, divergent, 8 to 10 cm. long, the lateral ones very slender, 5 to 10 mm. long Palea as long as the flowering glume, obtuse, acute, or with two short, slender awns at the apex. Internodes of the rachis 4 to 5 mm. long, linear-compressed, glabrous.

Type collected by A. D. E. Elmer, No. 266, on rocky hilltops, Almota, Whitman County, Wash., June 13, 1896; also collected by C. V. Piper, No. 2598, on dry, gravelly prairies, Spokane, June 25, 1897; and Robert M. Horner, No. 574, Waitsburg, Wash., June 3, 1897.

This species may be separated from *Sitanion polyantheris*, to which it is closely related, by the short, rigid, hirsute basal culm leaves.

3. **SITANION MULTISETUM** J. G. Smith, sp. nov.

Culms 3 to 5 dm. high, terete, striate, glabrous or minutely strigose-pubescent, erect or slightly geniculate, much branched from the very base. Sheaths rather loose, open at the throat, scarious along the margins above, strigose-pubescent and hirsute on the back, mostly longer than the internodes. Ligule very short, membranaceous. Blades 5 to 10 cm. long, rigid, erect or ascending, linear, acute and pungently pointed, flat, becoming involute, sparsely hirsute on the back, scabrous on the margins, hirsute and scabrous along the prominent nerves above. Spike erect, 5 to 8 cm. long. Spikelets two at each node but usually only one bearing perfect florets. Empty glumes many-parted nearly to the base, the slender, ascending, scabrous awns varying from 1 to 5 or rarely 8 cm. long. Lowest flowering glume of the sterile spikelet subulate, resembling the segments of the empty glumes, but somewhat lanceolate at the base. Flowering glume of the fertile spikelet about 8 or 9 mm. long, linear-lanceolate, rounded on the back, smooth and shining below, keeled and scabrous above, 3-awned, the middle awn stout, rigid, scabrous, 5 to 6 cm. long, the lateral ones slender, 3 to 8 mm. long. Palea as long as the flowering glume, acute or bicuspidate. Internodes of the rachis compressed, spatulate above, smooth and shining, scabrous along the margins, 4 to 5 mm. long.

Type specimen collected by Coville and Funston, No. 1121, Tehachapi Valley, Kern County, Cal., June 25, 1891. Other specimens which may be referred to this are Samuels, No. 225, Sonoma County, Cal.; a specimen collected by Bolander at San Francisco without date or number; Dr. Palmer, No. 2422, Petaluma, 1892; Hansen, No. 617, Clinton, Amador County, June 30, 1893; a specimen marked "J. A. Allen, California;" and L. Schoenefeldt, No. 3439, Nachoguero Valley, Lower California, June 14, 1894.

It differs from *Sitanion polyantheris* and *S. breviaristatum* in the very much longer and more rigid, erect or ascending awns of the empty glumes, and the leaves hirsute dorsally toward the base and along the nerves above.

4. SITANION POLYANTHERIX J. G. Smith, new name. *Polyantherix hystrix* Nees. in Ann. Nat. Hist. **1**: 284 (1838), not *Ægilops hystrix* Nutt.

Culms 3 to 4 dm. high, terete, striate, minutely strigose-pubescent. Sheaths striate, scabrous, closely enveloping the internodes and longer than them, hirsute. Ligule very short, membranaceous. Blades 6 to 25 cm. long, linear, long-attenuate or filiform, involute, acuminate, the lower hirsute on the back, the upper smooth, scabrous and sparsely hirsute on the nerves above. Spike 7 to 10 cm. long, rather rigid and densely flowered. Spikelets 2 at each node; all the florets of one of the spikelets sterile and the lowest and uppermost florets of the other either staminate or sterile, only the second producing seed. Empty glumes 5- to many-parted from near the base, the segments extending into slender, abruptly divaricate awns, 6 to 25 mm. long. Flowering glume of the hermaphrodite floret linear-lanceolate, acute, smooth and shining for its lower two-thirds, slightly scabrous above, with a rigid, scabrous awn 2.5 to 3 cm. long arising from between two minute teeth. Palea a little longer than the flowering glume, acute. Internodes of the rachis very short, smooth and shining, compressed, broadest above, about 3 mm. long.

✓Type collected by Douglas, in California. There is a specimen in the National Herbarium, labeled *Sitanion polyantherix*, which was collected by Dr. J. M. Bigelow, surgeon and botanist to Lieut. A. W. Whipple's expedition for a railway route from the Mississippi River to the Pacific Ocean, near the thirty-fifth parallel of latitude in 1853–54, California, without locality, and it is from this plant that the above description is drawn.

This species may be separated from *S. breviaristatum*, to which it is related, by the very long-attenuate, filiform leaves, and taller and more slender culms.

5. SITANION BREVIARISTATUM J. G. Smith, sp. nov.

Low, cæspitose perennial, with slender, erect spikes and very long, rigid, erect or ascending leaves. Culms about 2 dm. high, erect, clothed with dead leaf-sheaths at the base. Sheaths smooth, closely enveloping and longer than the internodes, scarious along the margins. Ligule nearly obsolete. Blades 5 to 15 cm. long, linear, rigid, pungently pointed, densely strigose pubescent on both surfaces, closely involute. Spike slender, rigid, 3 to 6 cm. long. Empty glumes 2- to many-parted, bearing scabrous, flexuous, divergent awns, from 7 to 20 mm. long. Flowering glume about 6 mm. long, narrowly lanceolate, smooth below, scabrous above, tipped with a short, rigid awn from 1 to 1.5 cm. long. Palea as long as the flowering glume, acute, 2-nerved, scarious along the margins, bicuspidate. Grain adherent to the palea, elliptical, oblanceolate, 5 mm. long, compressed, acute at the base, rounded at the apex. Internodes of the rachis compressed, 4 to 5 mm. long, spatulate above, glaucous.

✓Type specimen collected by Coville and Funston, No. 833, Willow Creek Canyon, Panamint Mountains, California, May 22, 1891.

This species differs from *Sitanion multisetum* to which it is related, in the low, densely cæspitose habit; short, slender spikes; and very short awns of the empty and flowering glumes. The bases of the culms are clothed with papery leaf-sheaths.

§§ **Eusitanion.** *Lowest floret of one or both spikelets sterile and like the empty glumes; some of the empty glumes bifid from about the middle, the divisions divergent: the others entire, subulate-setaceous.*

6. SITANION MINUS J. G. Smith, sp. nov.

Culms 1.5 to 2 dm. high, slender, rigid, erect, terete, glabrous. Nodes glabrous. Culm leaves 5. Sheaths glabrous, closely enveloping and longer than the internodes. Ligule almost obsolete. Blades 5 to 7 cm., those of the innovations 8 to 12 cm. long, rigid, erect or somewhat divaricate, linear, acuminate, involute, smooth and glabrous on the back, scabrous on the margins, strigose-pubescent on the nerves above. Spikes 3 to 5 cm. long, slender, their bases included in the

upper leaf sheaths, closely-flowered. Empty glumes 4, subulate or one of the lateral ones often lanceolate and 2-nerved, bifid from above the middle, scabrous, 25 to 32 mm. long. Spikelets 2-flowered, both florets of one of them sterile, reduced to subulate awns. Lower floret of the other hermaphrodite, the flowering glume 5 mm. long, lanceolate, strongly nerved and scabrous above the middle, smooth below, entire, tipped by a slender scabrous, subflexuous awn about 3 cm. long. Palea as long as the flowering glume, bicuspidate. Second floret rudimentary, awned. Internodes of the rachis 2 to 3 mm. long, spatulate, glabrous.

Type collected by L. Schoenefeldt, No. 3277, International Boundary Commission. Jacumba Hot Springs, near monument 233, altitude 900 m., May 24, 1894.

Related to *Sitanion multisetum*.

7. SITANION RIGIDUM J. G. Smith, sp. nov.

Culms 1 to 2 dm. high, terete, striate. Nodes glabrous. Sheaths longer than the internodes, smooth and glaucous, or the lower ones hirsute, open at the throat. Ligule cartilaginous, 1 mm. long. Blades 3 to 8 cm. long, 2 to 3 mm. wide, rigid, involute, smooth and glaucous on the back, obtuse or acute at the apex, scabrous along the margins and nerves above. Spike 2 to 8 cm. long, ascending, exserted its own length, or the base included in the uppermost leaf-sheath; empty glumes 4 and entire, or 6 (*i. e.*, the two lateral ones at each node divided to the very base) awned, strongly divaricate, 2 to 3 cm. long. Lowest floret sometimes sterile, like the empty glumes. Spikelets few-flowered. Flowering glume 7 to 9 mm. long, linear-lanceolate, trifid, smooth and glaucous below, scabrous above, tipped with a stout, divergent awn 3 to 4 mm. long. Internodes of the rachis 3 to 4 mm. long, compressed, scabrous on the margins.

Type collected by O. D. Allen, No. 178, Cascade Mountains, Washington, 1896. Other specimens examined are Elmer, No. 1145, Washington, 1898; and G. R. Vasey, Washington, 1889; H. E. Brown, No. 372, north side of Mount Shasta, California, 1897; R. M. Horner, No. 579, Blue Mountains, Washington, July 29, 1897; A. Nelson, No. 1021, Union Pass, Wyoming, August 13, 1895; J. N. Rose, No. 271, Timber Reserve, northwest Wyoming, August 28, 1893; Frank Tweedy, No. 79, Teton Forest Reserve, Wyoming, July, 1897; and S. Watson, No. 1337, E. Humboldt Mountains, Nevada, August, 1868.

This grass is related to *S. glabrum*, differing in the dwarf habit of growth and rigid glaucous leaves.

8. **SITANION CALIFORNICUM** J. G. Smith, sp. nov.

Culms low, ascending, 1.5 to 2.5 dm. high, terete, striate, densely pubescent above, geniculate at the nodes. Sheaths longer than the internodes, the lower ones densely hirsute, the upper minutely puberulent, the uppermost many times longer than the blade. Ligule obsolete. Blade 2 to 8 cm. long, 3 to 4 mm. wide, rigid, divaricate or ascending, prominently striate, linear-lanceolate, abruptly contracted at the base, attenuate toward the obtuse or subacute apex, scabrous above and on the margins, densely puberulent on the back. Spike subflexuous, erect or ascending, loosely few-flowered, 5 to 8 cm. long, barely exserted or the base inclosed in the uppermost leaf-sheaths. Lowest floret of one of each pair of spikelets sterile. Empty glumes 4, entire, subulate-setaceous, divaricate, 3 to 5 cm. long. Flowering glume linear, acute, abruptly rounded at the base, 10 to 12 mm. long, finely scabrous, terminating in a stout, divaricate, scabrous awn about 4 cm. long, arising from between two minute lateral setæ. Palea 2 mm. shorter than the flowering glume, truncate or obtuse, scabrous on the nerves above. Internodes of the rachis compressed, 4 to 5 mm. long, scabrous throughout.

Type collected by S. B. Parish, No. 3295, San Bernardino Mountains, California, altitude 2,150 m., June 23, 1894. Closely related to *S. rigidum*, but with leaves pubescent throughout and longer flowering glumes.

9. **SITANION GLABRUM** J. G. Smith, sp. nov.

Culms erect, terete, smooth and shining, glaucous. Sheaths glaucous, glabrous, rather closely enveloping and shorter than the internodes, scarious along the margins, open at the throat. Ligule membranaceous, almost obsolete. Blades 7 to 15 cm. long, 2 to 5 mm. wide, broadly linear, acute, flat becoming involute, smooth and glabrous on the back, scabrous-pubescent along the nerves above. Spike 5 to 8 cm. long, slender, subflexuous, its base inclosed in the swollen uppermost sheath. Empty glumes bifid from the very base, the lobes subulate, setaceous, 6 to 8 cm. long, subflexuous, slender, divaricate. Flowering glume 7 to 8 mm. long, rounded on the back, smooth and shining for its lower two-thirds, linear-lanceolate, acute, entire or minutely bifid at the apex, tipped with a slender, rigid, setaceous awn 4 to 5 cm. long. Palea as long as the flowering glume, bidentate, scabrous on the nerves above. Internodes of the rachis obcuneate, compressed, about 3 mm. long.

√Type collected by Coville and Funston, No. 914, near Crystal Spring, Coso Mountains, California, June 12, 1891. Also collected by J. A. Allen, California, without date or locality. No. 821, Hall, San Jacinto Mountains, may be placed here; and also Purpus, No. 5289, Pah Mountains, 1897. The latter has the habit of typical *S. glabrum*, but the leaves and sheaths are minutely soft pubescent and the spikelets and empty glumes purplish. Other specimens examined are: L. Schoenefeldt, No. 3609, Laguna, Cal., June 14, 1894; and C. V. Piper, No. 1952, dry slopes Mount Rainier, Wash. 2,100 m., August, 1895.

10. **SITANION INSULARE** J. G. Smith, sp. nov.

Culms slender, erect, terete, glabrous. Nodes glabrous. Culm leaves 4 or 5. Sheaths glabrous, closely enveloping the culm, open at the throat, shorter than the internodes. Ligule almost obsolete. Blades linear, 1 to 1.5 dm. long, glabrous on the back, strongly nerved and strigose-pubescent on the nerves above, scabrous along the margins. Spike slender, 5 to 8 cm. long. Empty glumes lanceolate, bifid and 2-awned, 4 to 5 mm. long, 2 mm. wide, tipped with divergent, slender, scabrous awns, 10 to 20 mm. long. Flowering glume 8 mm. long, linear-lanceolate, smooth and shining, glabrous for the lower two-thirds, rounded on the back below, keeled above, 3-toothed, the middle nerve extending into a stout, scabrous, divaricate awn about 15 mm. long; lateral teeth 1 to 2 mm. long. Palea as long as the flowering glume, 2-toothed at the apex. Internodes of the rachis linear, dilated above, sharply 2-edged, scabrous on the margins, 7 to 10 mm. long.

√Type collected by Sereno Watson, No. 1338, Carrington Island, Salt Lake, Utah, June, 1869.

This species is quite distinct from any other in the National Herbarium. It has the broad empty glumes of *Elymus*, but two-parted, as in *Eusitanion*, with divaricate awns. The empty glumes are inserted as in *Sitanion*, while the form of the spikelets and the habitat of the inflorescence resembles some species of *Agropyron*. As in the other *Sitanion* species the rachis breaks up into segments at maturity.

11. **SITANION CINEREUM** J. G. Smith, sp. nov.

Slender, ascending, leafy perennial, 2 to 3 dm. high, the entire plant ashy-gray with a close, dense pubescence. Innovations as long as the culms. Culms slender, terete, pubescent. Nodes glabrous. Sheaths closely enveloping the internodes and shorter than them, densely ciliate-pubescent. Ligule almost obsolete. Blades linear, rigid, involute, the uppermost 5 to 7, the lower 15 to 20 cm. long, densely strigose-pubescent on the nerves above, soft-pubescent or hirsute below. Spike slender, 4 to 5 cm. long. Empty glumes very scabrous, bifid, 2-awned, the strongly divergent scabrous awns 2 to 3 cm. long. Flowering glumes 7 to 8 mm. long, rounded on the back, scabrous throughout, 3-nerved toward the apex, 3-awned, the lateral awns very slender, 2 to 4 mm. long, the middle one stout,

SITANION HYSTRIX (Nutt.) J. G. Smith.

Photograph of Nuttall's type in the Herbarium of the Philadelphia Academy of Science.

divaricate, 2 to 3 cm. long. Palea as long as the flowering glume, tipped with two slender scabrous awns. Internodes of the rachis scabrous along the margins; 2 to 4 mm. long.

Type collected by S. M. Tracy, No. 222, Reno, Nev., 1887.

It differs from any other specimen in the National Herbarium in being densely grayish-pubescent throughout. In the character of the spikelets it approaches *S. hystrix*. No. 127, Suksdorf, Bickleton, Yakima County, Wash., June 7, 1884, with similar leaves and inflorescences, but the plant less densely pubescent and quite glaucous, may be placed here. Also a specimen collected by Dr. C. H. Merriam on Mount Shasta, California, 1898.

12. **SITANION HYSTRIX** (Nutt.) J. G. Smith, new combination. (*Ægilops hystrix* Nutt. Gen. N. Am. Pl., **1**: 86, 1818.) Pl. II.

Culms 1 to 3 dm. high, slender, erect or ascending, scabrous above, clothed at the base with papery leaf-sheaths. Innovations very leafy, one third to two-thirds the length of the culms. Sheaths striate, strigose-pubescent, open at the throat, closely enveloping the internodes. Ligule almost obsolete. Blades narrowly linear, flat or at length involute, strigose-pubescent throughout, prominently 9-nerved, scabrous along the margins, erect or ascending; those of the innovations 7 to 12 cm. long, 1 to 2 mm. wide; culm leaves about as long, 2 to 4 mm. wide. Spike 5 to 7 cm. long, erect or subflexuous, exserted, or its basal portion inclosed in the uppermost leaf-sheath, closely flowered. Spikelets 3- to 4-flowered, compressed. Empty glumes bifid, from near the base and unequally 2-awned; the strongly scabrous, glaucous, divergent awns, 3 to 4 cm. long. Flowering glume 7 to 8 mm. long, linear-lanceolate, minutely pubescent, 3-awned, the middle awn rather slender, recurved, about 3 cm. long. Palea as long as or longer than the flowering glume, scabrous, tipped with two slender awns, 2 to 3 mm. long. Internodes of the rachis glaucous, linear, not at all dilated above, about 5 mm. long.

A common, worthless bunch grass on shale hills and among the sagebrush on the high plains from western Colorado to eastern Washington.

SPECIMENS EXAMINED: *Wyoming:* P. A. Rydberg, No. 2028, Wamsutter, July 24, 1895; C. L. Shear, No. 280½, Wamsutter, June 21, 1895; No. 283, Green River, June 25, 1895; Thomas A. Williams, No. 2437, dry rocky hillsides, Evanston, July 10, 1897; No. 2379, dry sagebrush hills, Green River, July 9, 1897; Aven Nelson, No. 3058, Green River Hills, May 31, 1897; No. 3669, Wamsutter, July 10, 1897; No. 3784, North Vermilion Creek, July 20, 1897.

Washington: C. V. Piper, No. 2579, on sagebrush land, Ellensburg, July 9, 1897. A. B. Leckenby, Walla Walla, July 12, 1898.

Colorado: John Wolfe, No. 623, 1873; C. Thomas, 1869; and F. E. Clements, No. 60, Walsenburg, July 10, 1896.

There are in the herbarium of the Philadelphia Academy of Science two of Nuttall's specimens of *Sitanion*. One of these, labeled "*Chretomeris trichoides*, R. Mts. Platte," is exactly identical with No. 3784, A. Nelson, and No. 283, C. L. Shear, both collected in the Red Desert of Wyoming. The other, labeled "*Elymus difformis*, R. Mts. Platte," is nearly identical with No. 2028, Rydberg, from Wamsutter, Wyo. If these specimens are those from which Nuttall's description of *Ægilops hystrix* was drawn, and they agree better with his description than any specimen from the "arid plains of the Missouri" so far examined, then there was undoubtedly a mistake made in referring the habitat of this to that locality.

I am assured by Dr. E. L. Greene that it is highly improbable that Rafinesque drew his description of *S. elymoides* from Nuttall's plant, and it is certain that Rafinesque's description (Journ. Phys. **89**: 1819) differs in important particulars from that of *Ægilops hystrix*, Nuttall. I am, however, unable definitely to identify any *Sitanion* with which I am familiar as the true *S. elymoides*, Raf. The locality, "Missouri," of 1819, was then applied to what now constitutes several large

States in which a dozen or more separate species occur. Rafinesque apparently left no type, and the original description is too fragmentary to enable one to more than guess at the identity of the plant which he described.

13. **SITANION CÆSPITOSUM** J. G. Smith, sp. nov.

Densely cæspitose, with flat leaves, and weak, ascending culms. Sterile shoots very leafy, erect or spreading, 1 to 2 dm. long. Culms 2 to 3 dm. high, very slender, terete, glabrous. Nodes glabrous. Sheaths striate, open at the throat, smooth and glabrous. Ligule membranaceous, entire, very short. Blades 4 to 10 cm. long, 2 to 3 mm. wide, linear, flat, or the margins incurved, prominently 7-nerved above, glabrous on the back, scabrous above. Spike 4 to 6 cm. long, its base sometimes inclosed in the uppermost sheath, mostly exserted, somewhat flexuous. Empty glumes entire or bifid, 3 to 4 cm. long, divaricate, scabrous. Flowering glume of the lowest fertile floret linear-lanceolate, entire, smooth and shining below, sparsely scabrous above the middle, about 7 mm. long, tipped with a flexuous scabrous awn, about 5 mm. long. Callus rounded, glabrous. Palea as long as the flowering glume, rounded at the apex. Joints of the rachis glabrous, except along the margins, not at all dilated above, two-thirds the length of the lowest floret.

Growing in rich soil in the canyons around Silver City, N. Mex.

Type specimens collected by Jared G. Smith, near Cliff, N. Mex., August 19, 1897. Also collected at the same locality in August, 1896. It grows only in shaded canyons, and on moist talus slopes in the mountains at an altitude of about 2,000 m. Its leaves continue green during the winter. It is one of the "mutton grasses," formerly abundant and highly valued as forage for sheep and cattle, now to be found only in protected situations. Probably also occurring in the mountains of western Texas, although there are no specimens from any other locality than the typical one in the National Herbarium.

Closely related to *S. hystrix* (Nutt.) JGS., but the sheaths and blades are glabrous on the back.

14. **SITANION MONTANUM** J. G. Smith, sp. nov.

Culms rather stout, erect, 2 to 4 dm. high, terete, striate, glabrous below, scabrous above. Sheaths rather loose, open at the throat, as long as, or longer than, the internodes, smooth, scabrous or pubescent. Blades 5 to 10 cm. long, 3 to 4 mm. wide, linear, acuminate, flat or involute, pubescent on the back, scabrous or strigose-pubescent on the prominent nerves above, scabrous along the margins, rigid, erect or ascending, the uppermost usually shorter than the spike. Spike erect, loosely flowered, 5 to 10 cm. long. Empty glumes subulate, scabrous, long-awned, some of those in the lower part of the spike unequally bifid, the lobes extending into scabrous, divergent awns 5 to 6 cm. long, 2 or often 3 spikelets at each node. Lowest floret sterile. Flowering glumes 10 to 11 mm. long, linear-lanceolate, rounded on the back, smooth and shining for the lower third, scabrous above and on the margins, trifid, three-awned, the scabrous, divergent middle awn 4 to 7 cm. long, the lateral awns very short, slender. Palea as long as the flowering glume, with two short, setaceous, scabrous awns, or sometimes rather obtuse and muticous. Internodes of the rachis linear or dilated above, compressed, glaucous, 4 to 6 mm. long.

S. montanum differs from *S. strigosum* in the shorter, flat, and more rigid erect leaves and smoother flowering glume. This may be Rafinesque's *S. elymoides*.

Northern Wyoming and Montana to Oregon. SPECIMENS EXAMINED: *Montana:* F. Lamson-Scribner, No. 437, gravelly bottoms, Indian Creek, July 4, 1883; rather densely cinereous-pubescent throughout. P. A. Rydberg, No. 3091 (type), Spanish Creek, July 15, 1896; and No. 3133, Spanish Basin, July 18, 1896. Thomas A. Williams, No. 2002, Spanish Creek Basin, July 16, 1896, on sterile, rocky soil.

Wyoming: Thomas A. Williams, No. 2776, Bull Camp, August 2, 1897; and No. 2596, Ten Sleep Lakes, Big Horn Mountains, August 19, 1897.

SITANION BREVIFOLIUM J. G. Smith. Typical.

Idaho: B. W. Everman, No. 319, shores of Petit Lake, August 13, 1895.

Oregon: A fragmentary specimen collected by the U. S. South Pacific Exploring Expedition, under the command of Captain Wilkes, 1838–1842, is doubtfully referred here.*

15. **SITANION STRIGOSUM** J. G. Smith, sp. nov.

Culms stout, erect, 3 to 6 dm. high, terete, striate, glabrous, the uppermost internodes minutely pubescent. Nodes brownish, glabrous. Sheaths open at the throat, loose, striate, scarious along the margins above, more or less densely pubescent, as long as or longer than the internodes. Ligule nearly obsolete. Blades 1 to 2.3 dm. long, 3 to 6 mm. wide, linear to linear-lanceolate, flat or the lower ones involute, rounded at the base, long-acuminate pointed, strongly nerved, strigose-pubescent throughout, sparsely hirsute along the nerves, scabrous on the cartilaginous margins. Spike stout, erect, exserted, 8 to 12 cm. long. Empty glumes with the awn 5 to 6 cm. long, entire or bifid, scabrous, long-awned, divaricate. Flowering glumes 8 to 10 mm. long, lanceolate, rounded on the back, scabrous and glaucous, strongly 3-nerved above, the middle awn stout, recurved, scabrous, 5 to 7 cm. long, the lateral ones 1 to 2 mm. long. Palea nearly as long as the flowering glume; bifid, with two short awns, ciliate along the nerves above.

Type collected by P. A. Rydberg, No. 3298, Sheep Creek, Montana, August 8, 1896. Also collected by Charles A. Geyer, June 10, 1839, "in heavy ferruginous loam, Missouri, James and Shienne River valleys," probably at the eastern border of the Bad Lands, above Mandan, N. Dak.

S. strigosum differs from *S. montanum* in the very long, less rigid, more strongly nerved culm leaves, the uppermost nearly as long as or much exceeding the spike, those of the innovations half the length of the culm. The flowering glumes are more scabrous and shorter. This may be Rafinesque's *S. elymoides.*

16. **SITANION MOLLE** J. G. Smith, sp. nov.

Culms stout, erect, rigid, 3 to 4 dm. high, clothed at the base with dead leaf-sheaths, terete, striate, pubescent. Innovations about half as long as the culm. Nodes glabrous. Sheaths rather loose, open at the throat, longer than the internodes, pubescent, the lower ones sparsely hirsute along the nerves, the upper puberulent and scabrous on the nerves. Ligule entire, almost obsolete. Blades rigid, erect or ascending, linear, long-acuminate pointed, 8 to 15 cm. long, 3 to 5 mm. wide, the uppermost longer than the spike, soft-pubescent throughout, scabrous along the cartilaginous margins, on the nerves above and along the midrib beneath. Spike 7 to 8 cm. long, erect, loosely flowered, shortly exserted. Empty glumes 4, entire or unequally bifid, subulate-setaceous, 6 to 7.5 cm. long, scabrous, divaricate. Lowest floret of one of the spikelets sterile and like the empty glumes. Flowering glume of the lowest hermaphrodite floret linear-lanceolate, acute, 1 cm. long, smooth and shining, glaucous, trifid, or entire, tipped with a stout, spreading, scabrous awn 5 to 7 cm. long. Palea as long as the flowering glume, acute, or bicuspidate scabrous along the nerves.

Type collected by Shear and Bessey, No. 1469, East Side Buffalo Pass, Larimer County, Colo., moist, open mountain side, 3,200 m. August 14, 1898.

S. molle is related to *S. montanum.* It differs in being finely pubescent throughout. The leaves are longer and less strongly nerved.

§§§ **Hordeiformae.** *Lowest floret hermaphrodite. Empty glumes 4, entire.*

17. **SITANION BREVIFOLIUM** J. G. Smith, sp. nov. Pl. III.

Culms 3 to 6 dm. high, terete, stout, erect, obscurely striate, glaucous. Innovations less than half the length of the culms. Nodes glabrous. Sheaths smooth, scarious along the margins, glaucous, longer than the internodes, the uppermost much elongated, the lower sometimes pubescent or hirsute. Ligule almost

obsolete. Blades 5 to 10 or rarely 12 cm. long, 3 to 4 mm. wide, linear, acuminate, flat or involute, rigid, divergent or ascending, smooth and glaucous on the back, scabrous-pubescent along the prominent nerves above. Spike 7 to 15 cm. long, loosely few-flowered, long-exserted. Empty glumes stout, setaceous, divergent, 5 to 9 cm. long, smooth and shining and often glaucous at the base, scabrous above. Flowering glumes 8 to 10 mm. long, linear-lanceolate, glaucous, scabrous throughout, rounded on the back below, nerved above, entire, tipped with a stout, scabrous, spreading awn 4 to 8 cm. long. Palea as long as the flowering glume, scabrous on the margins above, obtuse. Joints of the rachis compressed, glaucous, 5 to 10 mm. long, linear. Closely related to *S. longifolium*, but the culm leaves shorter and more rigid and the innovations less than half as long as the culms.

Type collected by J. W. Toumey, No. 797, Tucson, Ariz., 1892.

SPECIMENS EXAMINED, *Colorado:* Tracy, Earle & Baker, No. 4274, Hamors Lake, July 24, 1898; No. 429, Mancas, July 8, 1898; No. 4272, Durango, July 18, 1898. C. L. Shear, No. 1087, Breckenridge, August 29, 1896; No. 1070, Dillon, August 26, 1896; No. 612, Georgetown, August 17, 1896; No. 997, Westcliffe, August 12, 1896; No. 912, Marshall Pass, July 27, 1896; No. 1003, Buena Vista, August 15, 1896; No. 814 and 833, Veta Pass, July 13, 1896; No. 1096, Como, September 1, 1896; No. 1240, Animas Canyon, August 5, 1897. P. A. Rydberg, No. 2414, Georgetown, August 20, 1895; No. 2509, Boulder, September 3, 1895. Shear & Bessey, No. 1407, Egeria Park, August 4, 1898. Patterson, Georgetown, 1875.

Wyoming: Thomas A. Williams, No. 2573*a*, Iron Mountain, July 2, 1897, and No. 2621, Bear Lodge, July 23, 1897; A. Nelson, No. 3952, Albany County, August 9, 1897.

Utah: Marcus E. Jones, No. 5663*bd*, Marvine Laceolite, July 23, 1894; No. 5684*bb*, Mount Ellen, Henry Mountains, July 25, 1894, and 5770*p*, Fish Lake, August 7, 1894.

18. **SITANION LONGIFOLIUM** J. G. Smith, sp. nov.

Culms 3 to 5 dm. high, stout, ascending, somewhat geniculate at the base, glaucous. Leaves of the innovations 1.5 to 3 dm. long, attenuate, involute, often as long as the culms. Nodes glabrous. Sheaths scabrous and glaucous, or more or less strigose-pubescent, or sparsely hirsute, longer than the internodes, loose, open at the throat, scarious along the margins above. Ligule entire, almost obsolete. Blades linear, long, attenuate, acuminate, striate, smooth and glaucous or pubescent, or sparsely hirsute on the back, 1 to 2 dm. long, 1 to 3 or 4 mm. wide. Spike subflexuous or somewhat nodding, 1 to 1.3 dm. long, rather loosely flowered, its base inclosed in the inflated uppermost leaf-sheath. Spikelets 2 or rarely 3 at each node. Empty glumes subulate setaceous, divaricate, scabrous, 6 to 8 cm. long. Flowering glumes 8 to 11 mm. long, scabrous, glaucous, rounded on the back below, keeled above, entire or minutely trifid, tipped with a stout, scabrous divaricate awn 5 to 6.5 cm. long. Palea as long as the flowering glume, obtuse or bicuspidate, scabrous on the nerves above. Internodes of the rachis compressed, glaucous, 6 to 8 mm. long. Closely related to *S. brevifolium*, from which it may be distinguished by the long attenuate flexuous leaves of the culms and innovations and by the subflexuous spikes, inclosed at the base in the uppermost leaf-sheaths.

Type collected by C. L. Shear, No. 1213, near Silverton, Colo., August 4, 1897, among rocks on the open sides of a canyon, altitude 3,000 m.

SPECIMENS EXAMINED, *Colorado:* J. Wolfe, No. 1161–2–3, Denver, 1873. C. L. Shear, No. 1152 and No. 1158, Ouray, July 4, 1897; No. 886, Villa Grove, July 24, 1897; No. 836, Veta Pass, July 15, 1896; No. 717, Idaho Springs, August 27, 1895. M. E. Jones, No. 531, Idaho Springs, August 1, 1878. Tracy, Earle & Baker, No. 4275, Chicken Creek, July 6, 1898. P. A. Rydberg, No. 2497, Idaho Springs, August 28, 1895.

Kansas: C. H. Thompson, No. 21, Ulysses, June 26, 1893.

Wyoming: D. Griffiths, Nos. 493 and 500, Sundance, August 10, 1897; No. 576, Little Missouri Buttes, August 15, 1897; No. 669, Inyankara Mountain, August 23, 1897; A. Nelson, No. 1602, Laramie Peak, August 6, 1895.

Nevada: Shockley, without date or locality.

Arizona: Dr. Palmer, No. 534, 1876. G. C. Nealley, No. 171, Rincon Mountains, August, 1891.

New Mexico: C. Wright, No. 2076, in part, 1851–52. E. O. Wooten, No. 322, White Mountains, August 12, 1897.

Texas: J. Reverchon, Upper Concho River (Curtiss, No. 3536).

19. **SITANION PUBIFLORUM** J. G. Smith, sp. nov. 255, 31458

Low, cæspitose perennial, with stout, rigid, erect culms, 2 to 3 dm. high, and tufted, erect, rigid innovations, 1 to 1.5 dm. long. Culms terete, strigose-pubescent above. Culm leaves 3 to 5. Nodes glabrous, glaucous. Sheaths about as long as, or longer than, the internodes, open at the throat, not at all inflated, glabrous. Ligule obsolete. Blades puberulent on the back, rigid, linear-involute, pungently-pointed, scabrous above, the lowest 10 cm., the uppermost 1.5 to 4 cm. long and horizontally spreading or divaricate. Spike exserted, erect, about 5 cm. long. Empty glumes setaceous, divaricate, 4 to 6 cm. long, scabrous throughout, not at all lobed or divided. Spikelets 2½-flowered, the uppermost floret rudimentary. Flowering glume of the lowest floret 7 mm. long, linear-lanceolate, acute, with a rounded callus, scabrous and finely pubescent, tipped with a straight, erect, scabrous awn, 5 to 6 cm. long. Palea rounded or entire at the apex, as long as the flowering glume, scabrous along the margins. Joints of the rachis one-half to two-thirds as long as the lowest floret, dilated above, scabrous.

Arizona, New Mexico, and southeastern Colorado: Type No. 795, J. W. Toumey, Tucson, Ariz., 1892. Other specimens of this are No. 38, Toumey, south of Ashfork, Ariz., June 25, 1892; C. R. Orcutt, No. 2533, Congress, Ariz., April 21, 1896. A specimen from the Moqui country without data. A. A. & E. G. Heller, No. 3558, Santa Fe, N. Mex., May 21, 1897. C. S. Crandall, No. 535, Trinidad, Colo., May 13, 1892.

This species is distinguished from *S. brevifolium* by the rigid, convolute, erect, puberulent leaves, densely tufted at the base of the low culms, erect spikes, and smaller pubescent flowering glumes.

§§§**Elymoides.** *Empty glumes lanceolate, 2–5-nerved, entire or lobed, lowest floret hermaphrodite; spikelets 1 or 2 at a node, when 1, the empty glumes inclosing the spikelet as in Elymus and Agropyron: rachis of the spike articulate at the nodes.*

20. **SITANION PLANIFOLIUM** J. G. Smith, sp. nov.

Culms stout, erect, 5 to 6 dm. high, the lower internodes smooth and shining, glaucous, terete, the uppermost slightly striate, glabrous. Sheaths striate, glaucous, open at the throat, loose. Ligule obsolete. Blades 8 to 15 cm. long, 5 to 8 mm. wide, flat, lanceolate, becoming involute toward the acuminate apex, scabrous above, and along the cartilaginous margins, glabrous on the back, more strongly nerved below than above. Spike erect or somewhat nodding, 6 to 9 cm. long, purplish, long-exserted. Spikelets subcylindrical, compressed. Empty glumes 6 to 7 mm. long, lanceolate, strongly 1- to 3-nerved, entire or bifid, glaucous at the base, strongly scabrous on the nerves above, tipped with a slender, spreading, scabrous awn, about 2 cm. long. Flowering glume 10 to 11 mm. long, lanceolate, flat or rounded on the back, glaucous, sparsely and minutely scabrous, bearing a stout, scabrous awn 3 to 4 cm. long. Palea as long as, or slightly longer than, the flowering glume, glaucous, scabrous, obtuse at the apex. Joints of the rachis linear, compressed, dilated above, glaucous, 5 mm. long, very sharply 2-edged, scabrous on the margins.

Type collected by W. N. Suksdorf, No. 224, high mountains, Skamania County, Wash., August 10, 1896.

Closely related to *S. lanceolatum*, from which it differs in the glaucous sheaths and culms, flat, lanceolate leaves which are very smooth on the back, and the purplish, long-exserted spikes with glaucous florets.

21. **SITANION LANCEOLATUM** J. G. Smith, sp. nov.

Culms 2.5 to 5 dm. high, erect or ascending, and somewhat geniculate at the lower nodes. Culms terete, smooth and ascending, striate above. Nodes glabrous. Sheaths glabrous, striate, closely enveloping the culms, longer than the internodes. Ligule almost obsolete. Blades 8 to 15 cm. long, 2 to 3 mm. wide, rather rigid, linear, erect, or the basal ones divergent, flat or convolute, glabrous on the back, scabrous on the margins and nerves above. Spike erect, 6 to 10 cm. long, barely exserted, or its base included in the uppermost leaf-sheath. Spikelets cylindrical, subcompressed, the florets closely overlapping one another. Empty glumes 5 to 6 mm. long, keeled, lanceolate, 2-nerved, oblique, scarious on the margins, entire or unequally 2-awned, the longer awn scabrous, divergent, 10 to 15 mm. long. Flowering glume 8 to 9 mm. long, glaucous, rounded on the back, lanceolate, entire, or minutely 3-toothed at the apex, with a stout, scabrous, divergent awn 2 to 4 cm. long. Palea as long as its glume, obtuse or emarginate, scabrous on the margins above. Joints of the rachis, 5 to 7 mm. long, linear, spatulate, compressed, scabrous on the margins.

Type collected by P. A. Rydberg, No. 3381, Barker, Mont., August 17, 1896.

The habit of this grass resembles that of *Agropyron caninoides* Beal; the spikelets and empty glumes are arranged as in *Elymus*, but the nervation of the empty glumes, trifid flowering glume, and the rachis dehiscent at the nodes, are sufficient characters to throw this species into *Sitanion*.

22. **SITANION HANSENI** (Scribn.) J. G. Smith, nom. nov. *Elymus hanseni* Scribn. U. S. Dept. Agr., Div. Agros., Bull. **11**: p. 56. 1898.

"A rather stout, glabrous perennial, 9 to 12 dm. high, with narrow, spreading leaves and slender fragile spikes 5 to 8 cm. long. Sheaths smooth, striate. Ligule very short, hardly 1 mm. in length, entire. Leaf-blades 10 to 30 cm. long, 2 to 5 mm. wide. Internodes of the rachis about 1 cm. long. Spikelets 3- to 5-flowered, about 1.5 cm. long, exclusive of the awns. Empty glumes lanceolate, strongly nerved, tipped with 2, sometimes 3, unequal awns, the longer about 3.5 cm. First flowering glume 10 to 12 mm. long, entire or 2-toothed at the apex, terminating in a straight or very slender awn about 5 cm. long. Palea about the length of the glume, minutely scabrous on the sharp keels except at the base, slightly pubescent at the truncate or 2-toothed apex."

Amador County, Cal.

Related to *S. anomalum*, but taller and more slender, with mostly single rather remote spikelets, which are longer.

23. **SITANION ANOMALUM** J. G. Smith, sp. nov. (Pl. IV).

Culms erect or ascending, 5 to 6 dm. high, terete, smooth. Nodes glabrous. Sheaths smooth or the lower sparsely hirsute, ciliate along the margins, shorter than the internodes. Ligule membranous, 1 mm. long. Blades 4 to 12 cm. long, 3 to 4 mm. wide, involute, rigid, linear, long-attenuate, scabrous throughout. Inflorescence simple or thyrsiform, 1 to 1.5 dm. long, few-flowered, interrupted below, subflexuous. Spikelets compressed, 4-flowered, the florets distant. Empty glumes mostly lanceolate, entire, but those of the lowermost spikelets bifid above the middle, with short, scabrous, divergent awns 1 to 4 cm. long. Flowering glumes 1 cm. long, narrowly linear-lanceolate, rounded on the back, smooth below, scabrous above the middle, 3-aristate, lateral awns 1 to 2 mm. long, the middle one straight, erect, scabrous, 3 to 4.5 cm. long. Palea shorter than the flowering glume, obtuse, erose, or bidentate, scabrous along the margins and on the nerves. Internodes of the rachis 7 to 10 mm. long, ancipital, scabrous on the margins.

Type collected by O. D. Allen, near Pasadena, Cal., May 12, 1885. This grass is intermediate between true *Sitanion* and true *Elymus*. The habit is that of *Elymus*, but the articulate rachis, occasionally bifid empty glumes and trifid flowering glumes, indicate a close relationship with *Sitanion*.

DOUBTFUL SPECIES. *Sitanion elymoides* Raf.

SITANION ANOMALUM J. G. Smith. Cotype.

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BULLETIN No. 19.—REVISED. Agros. 66.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF AGROSTOLOGY.

[Grass and Forage Plant Investigations.]

THE STRUCTURE OF THE CARYOPSIS OF GRASSES WITH REFERENCE TO THEIR MORPHOLOGY AND CLASSIFICATION.

BY

P. BEVERIDGE KENNEDY, PH. D.,

EXPERT AND AGENT IN CHARGE OF EXPERIMENTAL WORK.

PREPARED UNDER THE DIRECTION OF F. LAMSON-SCRIBNER, AGROSTOLOGIST.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1900.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Division of Agrostology,
Washington, D. C., March 28, 1900.

Sir: I have the honor to transmit herewith a revised copy of Bulletin 19, of this Division, entitled The Structure of the Caryopsis of Grasses with reference to their Morphology and Classification, by P. Beveridge Kennedy, Ph. D., and recommend the publication of a second edition, the first edition being entirely exhausted. This paper contains much of histological interest, but is of special value on account of the important facts brought out in the investigations relative to the morphology and classification of grasses.

Respectfully,

F. Lamson-Scribner,
Agrostologist.

Hon. James Wilson,
Secretary of Agriculture.

INTRODUCTION.

The fruits and seeds of plants present characters which are less subject to variation than any of the other organs or parts. In consequence, these characters are of the highest importance in studying the classification and relationships of plants. They are employed in separating the larger groups, and in some cases ordinal characters are based upon them; and within many families the fruit affords the best differential characters for the separation of subtribes, and even genera. To what extent the fruit, or caryopsis, of grasses may be employed in determining the relationships of the various tribes and genera is to some extent indicated in the following paper. Enough is presented to show that the characters possess great value in this connection and clearly emphasize the interest and importance of a knowledge of the structure and morphology of the caryopsis of the different tribes of Gramineæ—a subject here treated for the first time in the English language.

The structure of the fruits of the cereals has been investigated to some extent at a number of the agricultural colleges and experiment stations, but the cultivated grains only represent three of the thirteen tribes of grasses.

F. LAMSON-SCRIBNER.

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THE STRUCTURE OF THE FRUITS OF GRASSES WITH REFERENCE TO THEIR MORPHOLOGY AND CLASSIFICATION.

HISTORICAL REVIEW.

The first writer to mention the fruits of grasses from a morphological point of view was Malphigi,[1] who described the embryos of *Triticum* and *Avena* in 1687. He regarded the scutellum as representing the cotyledon. Nothing further was written concerning the embryo of grasses for a hundred years, when Gaertner[2] described it in 1788. He studied a considerable number of species, especially in regard to the scutellum. The name "scutellum" was first used by him. He regarded the "vitellus" as a transition between the endosperm and the cotyledon. A. L. de Jussieu[3] in describing the grass fruit used the term "lobus" implying the cotyledon.

In the year 1808 Poiteau[4] concluded that the sheath in the embryo, called "vitellus" and "scutellum" by Gaertner, is a true cotyledon. He decided that the epiblast must be the rudiment of a second cotyledon, because of its position opposite to the cotyledon or scutellum. Richard[5] in the same year presented the view that the scutellum originates from the lower part of the radicle, and that therefore the scutellum is a lateral protuberance of the radicle. By imagining the plumule raised in such a manner that it stands at right angles to the long axis of the scutellum, he constructed a homology with the embryos of the *Naiadaceæ*, *Alismaceæ*, *Hydrocharidaceæ*, and *Nymphæaceæ*. The word epiblast originated with Richard. He regarded it as a continuation of the root sheath, basing his opinion on a section cut obliquely through the embryo of *Oryza*.

In 1809 Kirbel[6] compared a number of embryos of the grasses in the resting and germinating stages with those of other monocotyledons. He believed that the scutellum represented a cotyledon and that the epiblast was a reduced cotyledon. In another work[7] Kirbel regarded

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[1] Opera omnia. 1687.
[2] De fructibus et seminibus plantarum. 1788.
[3] Genera plantarum secundum ordines naturales disposita. P. 28. 1789.
[4] Mémoire sur l'embryon des Graminées, des Cypéracées et du Nelumbo. 1808.
[5] Analyse des embryons Endorh. ou Monoc. et part de cel. d. Gr. 1808.
[6] Eléments de Physiologie végétable, r. I. 1809.
[7] Examen de la division des végétaux en Endorhizes et Exorhizes. 1810.

the plumule-sheath as belonging to the cotyledon, but in 1815 returned to his former view. Treviranus[1] opposed Richard's view and regarded the scutellum as a cotyledon. He speaks of the scutellum as enlarging itself the length of the seed and taking on a yellowish color, which is certainly not the case. Turpin[2] agreed with Mirbel that the embryo has two cotyledons. According to Cassini[3] the embryo of the grasses is composed of an axis, a cotyledon, one or two radicles, a plumule, and one or two "carnodes." His "cotyledon" is the plumule-sheath, while the "carnode," a name for the scutellum, he regards as a protuberance of the radicle. Raspail[4] compared the fruit and the flower. He believed that there was also a homology between the embryo and the culm. On examining the cotyledon he discovered a large nerve, joining the two nerves of the plumule-sheath at the base. From this he concluded that the scutellum is homologous to the peduncle of the aborted flower in the spikelet and to the sheath of the culm-leaf. He compared the plumule-sheath with the two-nerved palet in the spikelet and to the first leaf of the vegetative bud, and the endosperm to the flowering glumes of the spikelet and to bracts on the culm.

Dr. C. A. Agardh[5] in 1826 compared a longitudinal section of the embryo of *Ruppia* with the grass embryo and fruit, and found a great similarity between them. He regarded the entire endosperm of the grasses as the cotyledon, and the scutellum as a covering of the same. This, however, is impossible, as the scutellum never surrounds the endosperm. Bernhardi[6] believed that a cotyledon must, aside from its function of nourishment, also act as a protective organ to the young leaves. He therefore regarded the plumule-sheath as a cotyledonary-sheath and the scutellum as a cotyledon. Bischoff[7] also believed that the scutellum and epiblast are two cotyledons. He regarded the caryopsis as having an embryo with alternate cotyledons, without however giving any special grounds for this opinion. M. J. Schleiden[8] was the first to study the development of the grass embryo. According to him the scutellum and the plumule-sheath together form the cotyledon. He regards the epiblast as an outgrowth of the cotyledon, since it is connected with the main axis lower down than the cotyledon

[1] Von der Entwickelung des Embryo und seiner Umhüllungen im Pflanzen-Ei. 1815.

[2] Mémoire sur l'inflorescence des Graminées. Ann. d. Mus. d'hist. Nat. 1819.

[3] L'analyse de l'embryon de Graminées, Jour. de Physique. T. 91. 1820.

[4] Sur la formation de l'embryon dans les Graminées. Ann. des Soc. Natur, Series 1, vol. 4, plates 13–14, 1824, 271–290. 1824.

[5] Über die Eintheilung der Pflanzen nach dem Cotyledon und besonders über den Samen der Monocotyledonen. 1 Nov. Act. C. B. C., T. XIII, P. I. 1856.

[6] Ueber der merkwürdigsten Verschiedenheiten des entwickelten Pflanzenembryo. Linnaea. 1832.

[7] Lehrbuch der Botanik I. 1834.

[8] Einige Blicke auf die Entwickelungsgeschichte des vegetale Organ bei den Phan., Wieg. Archiv. III, I. 1837.

itself. Adrien de Jussieu[1] differed from his father in the interpretation of the parts of the embryo, believing that the scutellum is not a true cotyledon but only a lateral appendage of the axis which resembles one. This view has been held by many up to the present time. Regel[2] considered the plumule-sheath the true cotyledon, and the scutellum first as a stipule and again later as a bract from which the plumule arises laterally. In the same year Reisseck[3] advanced the opinion that the plumule-sheath is an axillary bud and that the cotyledon (Samenlappe) is an organ of the aborted terminal bud and the protecting leaf of the plumule, and that the epiblast is united with the cotyledonary-sheath, which is evidently also a part of the cotyledon. Lestiboudois[4] regarded the plumule-sheath as the cotyledon, but considered the scutellum of no significance, because only the former is traversed by fibrovascular bundles, hence resembling two leaves grown together.

Hofmeister[5] interpreted the embryo in different ways, describing the development of *Zea*. He called the scutellum the cotyledon and the plumule-sheath a part of it. A few years later, in another work,[6] he compared the so-called scutellum of the embryos of *Zea* and *Andropogon sorghum* with the first leafless structures of *Zostera*. Demoor[7] investigated a large number of the fruits of grasses in the mature stage, and also their development. He regarded the scutellum as the true cotyledon of the grasses, and the plumule-sheath not as representing the ligule, but as a sheath of a primordial leaf. This would not, however, correspond to the alternating arrangement of the leaves of grasses, a difficulty which he bridges over by citing that there is no opening of the sheath in *Melica uniflora* because of the growing together of the two margins of the leaf. He admits, however, that he has not been able to observe this. J. C. Agardh[8] speaks of the embryo as sometimes presenting a thalloid form. Schacht[9] considered the scutellum as the cotyledon, the plumule-sheath as the first leaf, and the epiblast a part of the cotyledon.

Hofmeister,[10] writing again concerning the grass embryo, stated: "I still regard the scutellum of the grasses and the analogous structure

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[1] Sur les embryons monocotylédones. Compt. Rend. des Soc. de l'Acad. des Sciences, **9**: 15–31. 1839.

[2] Beobachtungen über den Ursprung der Stipeln. Linnaea, 17. 1843.

[3] Monocotylischer Embryo. Bot. Zeit. 1843.

[4] Phyllotaxie anatomique, Ann. des. sc. naturelles, ser. III, **10**: 15. 1848.

[5] Die Entstehung des Embryo der Phanerogamen. 1849.

[6] Zur Entwickelungsgeschichte des Zostera embryo. 1852.

[7] Note sur l'embryon des Graminées. Bull. de l'Acad. roy. des Sci. de Brux. 1853.

[8] Theoria system. plant. 1858.

[9] Lehrbuch der Anatomie und Physiologie der Gewachse. 2, 1859 und das Mikroscope, 224. 1862.

[10] Neue Beitrage zur Kenntniss der Embryobildung der Phanerogamen Abhand. der königl. sachs. Gesellschaft. d. Wien. 1861.

of *Zostera* as an outgrowth from the axis, and not as a leaf." In this he agrees with Adr. de Jussieu. A. Gris,[1] studying the embryo of *Zea* from a physiological standpoint, also regarded the cotyledon as a lateral expansion of the axis, modified in such a manner as to become the principal absorbing organ of the embryo.

Duchartre[2] stated that the embryo is remarkable in having an oval, flat, or slightly curved, bud-like expansion at its base, called by Gaertner the "scutellum." This organ directly adjoins the endosperm by its dorsal face. In front of it is another shoot, which Richard calls the "blaste." Le Maout and Decaisne[3] regarded the scutellum as a cotyledon, which is often split along its outer face, showing the radicle and plumule. The plumule is conical and composed of one to four primary convolute leaves. They regarded the plumule sheath as the first leaf of the plumule. Sandeen[4] investigated a large number of ripe embryos and concluded that the scutellum is a thallus formation and that the plumule is a protuberance of the axis.

Sachs[5] regarded the scutellum as an outgrowth of the axis beneath the cotyledon and the plumule-sheath as the cotyledon, enveloping the whole plumule like a mantle. Hanstein[6] studied the development of *Brachypodium* from the embryo sac to its maturity. He regarded the scutellum as a leaf and a cotyledon, and both the plumule-sheath and the epiblast as trichomatic projections. This is difficult to imagine. Van Tieghem[7] reviewed the subject, illustrating the parts of the embryos of *Triticum æstivum*, *Hordeum vulgare*, *Avena sativa*, *Phalaris canariensis*, *Zea mays*, and *Andropogon sorghum vulgare*, briefly stating his own objections to the views previously held. He considered that the scutellum and plumule-sheath together represent the cotyledon, which has at its opposite side a small protuberance called the lobule or epiblast. Owing to the presence of two vascular bundles in the plumule-sheath, he calls it a double stipule united at the margins, and homologizes the scutellum and plumule sheath with the leaf and ligule.

Hegelmaier[8] discussed the grass embryo from its developmental history, giving excellent figures of *Triticum æstivum*. He also noted the occurrence of secondary roots in *Coix*, *Hordeum*, *Secale*, *Avena*, *Triticum*, and other genera, concluding with Van Tieghem that the

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[1] Recherches anatomiques et physioloques sur la germination. Ann. des Sci. naturelles, ser. 5, **2**: 1864.

[2] Eléments de Botanique. 1867.

[3] Recherches anatomiques et physioloques sur la germination. Ann. des Sci naturelles, ser. 5, **2**: 1864.

[4] Bidrag till kaenn ed omen om Grasembryots byggnad och Utweckling. Acta Univers, Lundens, 1868.

[5] Lehrbuch der Botanik, 474. 1868. Eng. Trans. and revision by S. H. Vines, 1882.

[6] Die Entwickelung des Keimes der Monocot. and Dicot. Botanis. Abhand. 47. 1870. Taf. 14, figs. 11–21; Taf. 15–18.

[7] Sur les Cotyledons des Graminées. Ann. des Sci. naturelles, series 5, **15**: 723–726. 1872.

[8] Zur Entwickelungsgeschichte monocotylischer Keime, etc. Bot. Zeit. 1874.

scutellum and plumule-sheath together correspond to the cotyledon of the other monocotyledons. A. Stephen Wilson[1] held that the cotyledon of the grasses had not yet been correctly interpreted, and that the morphological interpretation lay in whether the two vascular bundles of the plumule-sheath represent the middle nerves of two leaves or whether they only occur to strengthen the organ. In comparing this with the leaves in the terminal bud of the rhizome of *Agropyron repens* he found a difficulty, owing to the latter being many-nerved. He believed that the scutellum certainly has the function of a cotyledon and is a nourishing organ for the embryo at germination, but whether the plumule-sheath is also a nourishing organ is left in doubt.

Gordon[2] studied the morphology of the inflorescence. He says that the node-like swelling at the base of the plumule-sheath occurs very generally in the grasses. It appears to be a part of the node, but in reality is only a circular swelling at the base of the closed sheath. The proper node lies underneath this swelling. The plumule-sheath must exercise a certain pressure on the axis, and if axillary buds are present this pressure must have a certain influence on the plumule. The author speaks of the well-known organ, which denotes the origin of a branch, and which is looked upon by most morphologists as a two-keeled simple "Vorblatt" (prophyllum), with its back turned toward the main axis. The axillary shoots in *Zea*, *Tripsacum*, *Coix*, and many others make a cavity or groove in the culm, showing that they have developed under pressure of the sheath. The tissue at the base of the culm remains soft and capable of growth for a long time as a basal vegetation point. In other grasses, such as *Arundo* and *Phalaris*, the axillary shoot does not press itself into the culm. In these the growing point breaks through the sheath to the light. In *Arundinaria* the sheath soon dries up and the growing point has nothing to hinder it. Attempting an analogy between the fruit and the spikelet, he concluded that the plumule-sheath represents two leaves grown together. Certain *Gramineæ*, he says, have one or two buds in the axil of the plumule sheath, each with a prophyllum.

Warming[3] regards the scutellum as the cotyledon and the plumule-sheath as an independent leaf, the latter because an internode is occasionally found. Klebs[4] agrees with Van Tieghem. Hackel[5] believes, as does Warming, that the epiblast is a rudimentary second cotyledon.

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[1] On the envelope of the plumule in the grass-embryo. Trans. and Proc. of the Bot. Soc. of Edinburgh. **13**: 457. 1879 (with plate).

[2] Etudes morphologiques sur la famille des Graminees. Revue des Sci. naturelles, Montpellier. 1879.

[3] Handbog i den Systematiske Botanik. Trans. by Potter. 1895.

[4] Beitrage zur Morphologie und Biologie der Keimung. Untersuch aus d. Bot. Institut der Lubingen.

[5] Echte Gräser. Engler und Prantl. Pflanzenfamilien, **2**: 1887. 2. Eng. Trans. by Scribner and Southworth. 1890.

Regarding it as a cotyledon explains the peculiar position of the first leaf over the scutellum. Many authors, he says, regard the plumule-sheath as a part of the cotyledon, surely an incorrect idea. Lermer and Holzner[1] in an exhaustive histological treatise on *Hordeum vulgare* describe in detail the different parts of the fruit. They regard the scutellum as a shield-like expansion of the hypocotyl, acting as a special absorption organ, and the plumule as composed of four leaves inclosed in a plumule-sheath, but attempt no interpretation of the latter view.

Bruns[2] has investigated the grass embryo chiefly from a systematic point of view. He describes and figures a large number of genera of each of the tribes. He regards the scutellum as one cotyledon, and the epiblast as a second, much reduced on account of the great development of the former. He considers it of no consequence from a systematic standpoint whether or not the scutellum and the epiblast are regarded as two cotyledons, provided it is granted that they represent two leaves, as the cotyledons are the first two leaves placed together. The plumule sheath is the thickened first leaf of the plumule especially adapted for protecting the young leaves. It has no blade, a common characteristic of the lower leaves of grasses. Schlickum,[3] in comparing the cotyledons of the monocotyledons, says that when the cotyledon has assimilating functions to perform its lamina displays a differentiation into a nutrient portion, the haustor, and a conducting portion, the conductor. In the grasses the conductor is very rudimentary or entirely suppressed, while the scutellum is transformed into the haustor, which bears no resemblance to a foliage leaf. The epiblast is probably an outgrowth of the coleorhiza. When the cotyledon does not emerge above the soil its function is to take up, by means of the haustor, the nutrient substances present in the endosperm, and to protect the rudimentary leaves by the formation of a more or less developed cotyledonary sheath.

Finally, Celakovsky[4] reviews the work of previous investigators and criticises them especially in regard to the homology of the epiblast and plumule-sheath. He believes that the true morphological nature of the parts can only be determined by investigating along many different lines, and if all these lines point toward the same conclusion, then surely it must be the correct one. The writer investigates the fruit according to the four following lines: (1) Ontogeny; (2) taxonomy; (3) anatomy; and (4) progressive and retrogressive metamorphoses. He then attempts to find out where the scutellum and plumule-sheath are joined at the base; where they separate; and whether the plumule-

[1] Beitrage zur Kenntniss der Gerste. Munchen, 1886. Extract by Brown and Morris Chem. Soc. Jour., vol. 57. 1890.

[2] Der Grasembryo. Flora, **76**: 1892.

[3] Morphologischer und anatomischer Vergleich der Cotyledon und ersten Keimblatter der Keimpflanzen der Monocotyledon. Bibl. botan. Heft. 35. 1896.

[4] Uber den Homologien der Grasembryo. Bot. Zeit., Sept. 1897.

sheath is inserted directly over the scutellum; and, finally, how the insertion of the plumule-sheath becomes separated so far from the scutellum through the elongation of the axis. He also homologizes the grass fruit with *Smilax*, *Potamogeton*, *Ficus elastica*, the mosses, and the leaf of the grasses. He regards the scutellum as the blade of the cotyledon, and as being homologous with the blade of the leaf. Over the scutellum is situated the plumule-sheath which is homologous to the ligule. The epiblast is the blade of an opposite second cotyledon.

SUMMARY.

The most important views of the different authors may be summed up as follows:

1. The scutellum is the cotyledon; the epiblast a second independent leaf; the plumule-sheath a third leaf; while the first true leaf is the fourth lateral appendage of the embryo.—(Malphigi, Mirbel, and Poiteau.)

2. The scutellum and the epiblast together form the cotyledon, the plumule sheath a second leaf, and the first true leaf becomes the third lateral appendage of the embryo.—(Schleiden, Shacht, and Decaisne.)

3. The plumule-sheath represents the cotyledon, the scutellum and epiblast being only expansions of the axis or of the radicle; and the first true leaf then becomes the second lateral appendage of the embryo.—(Richard, Adr. de Jussieu, Lestiboudois, Hofmeister, and Sachs.)

4. The scutellum is the central portion of the cotyledon, the epiblast an opposite appendage of it, and the plumule-sheath an ascending part in the form of a protective organ; the first true leaf then becomes the second lateral appendage of the embryo.—(Gaertner and Mirbel, at a certain time.)

5. The scutellum and the plumule-sheath together represent the cotyledon, and correspond to the blade and ligule of the culm-leaf: the epiblast is a protuberance of the cotyledon on the opposite side.—(Van Tieghem and Klebs.)

6. The sixth view is the same as the fifth, with the exception that the epiblast represents a second cotyledon opposite the scutellum.—(Celakovsky.)

7. The scutellum is one cotyledon and the epiblast is the other, the plumule-sheath being the first leaf of the plumule.—(Bruns.)

GENERAL DESCRIPTION OF THE FRUIT.

The embryo of grasses stands isolated from those of other monocotyledons in possessing two peculiar structures, the *epiblast* and plumule sheath. The following investigations were undertaken to determine the morphological significance and taxonomic value of these structures in the different tribes. Owing to the difficulties met with at the outset

in securing a suitable method, the work is not so complete as at first anticipated.[1]

The fruit of the *Gramineæ* was described first by Mirbel under the name "cerium" and rechristened later by Richard "caryopsis."

Its contents at maturity consist largely of endosperm and embryo, the tissues of the nucellus, ovule, and ovary being almost completely displaced. The only remnants of the nucellus which are recognizable in the ripe grain are the empty cells which spring from the funiculus, and the epidermis of the nucellus, which is continuous as a very attenuated layer of cells around both endosperm and embryo. Of the walls of the ovary only the inner one persists as a double layer of cells forming the testa or true coat of seed. Within the nucellus are one to four layers of cells with highly cuticularized walls. In section they are somewhat rectangular in form and constitute the gluten cells which contain the closely packed aleurone grains.

Lying between the starch-containing portions of the endosperm and the embryo is a comparatively thick layer of compressed cells belonging to the scutellum. They are for the purpose of dissolving the starchy material of the endosperm during germination. The endosperm consists of thin-walled cells packed closely with starch granules, embedded in a fine mass of proteid material. These starch-containing cells each possess a nucleus which is not easily recognized.

The embryo is situated laterally and at the base of the seed. It is differentiated into the scutellum, the plumule, the radicle, and frequently the epiblast. The plumule is surrounded by the plumule-sheath, which sometimes has a slit-shaped opening on the side opposite to that of the scutellum. The plumule sheath is composed of a vegetation point and several layers of leaves. The radicle is inclosed in the lower part of the embryo, and at germination, before making its exit, must break through a protective mass of tissue, the coleorhiza, so called because it forms a kind of sheath around the radicle. Secondary radicles frequently occur in the mature and resting embryo. They arise in the axis usually just below the plumule.

The vascular system may be traced down into the primary radicle, and also into the scutellum, plumule-sheath, and plumule.

THE SCUTELLUM.

The name "scutellum" has been given to the cotyledon of the grasses because of its resemblance to a little shield. It has for its object the protection of the plumule and the absorption of nutrient materials from the endosperm.

---

[1] The author wishes to express his thanks to Prof. W. W. Rowlee for many helpful suggestions during the progress of the work; also to Profs. F. Lamson-Scribner and W. J. Beal for much valuable material, and to Prof. F. C. Harrison, of the Ontario Agricultural College, at Guelph, Canada, and to Messrs H. R. Carveth and O. Shantz for aid in the discovery of a method.

Observing a cross section of any embryo, one sees that the scutellum surrounds the plumule like a sheath. In *Zea* (figs. 4 A–F, Pl. I), *Andropogon* (figs. 10 A and B, Pl. II), and others the plumule is almost completely surrounded by the scutellum, so that only a narrow opening may be seen. A longitudinal section of *Andropogon saccharatus* (fig. 9, Pl. II) shows the scutellum so completely surrounding the plumule that it appears as if an epiblast was present. By observing a cross section, however, it is seen that the margins of the scutellum surround the plumule with the exception of a small slit (fig. 10 B, Pl. II). At a point toward the apex of the plumule sheath the scutellum bears a protuberance which projects over the plumule. This is especially distinct in *Lygeum* (fig. 25, Pl. IV), *Lolium* (fig. 75, Pl. VIII), and *Ammophila* (fig. 42, Pl. V). This part has been called the cotyledonary sheath (c. s.) to distinguish it from the plumule-sheath (pl. sh.).

At the base of the scutellum there is another protuberance in many embryos, such as *Avena* (fig. 44, Pl. V), *Triticum* (fig. 69, Pl. VII), *Anthoxanthum* (fig. 29, Pl. IV), *Uniola* (fig. 61, Pl. VII), *Bulbilis* (fig. 58, Pl. VI), and *Beckmannia* (fig. 60, Pl. VI). Sometimes a deep cleft occurs, appearing as a separation of the radicle. In some embryos the scutellum has a distinct sheath and a blade. A striking example of this may be seen in *Avena* (fig. 44, Pl. V), *Spartina* (fig. 53, Pl. VI), and *Zizania* (fig. 22, Pl. III).

The attachment of the scutellum to the axis varies considerably in different embryos. *Desmazeria* (fig. 63, Pl. VII) and *Anthoxanthum odoratum* (fig. 29, Pl. IV) have the attachment directly at the base of the plumule. In others there is a lengthening of the axis with the attachment at the base, leaving a very small proportion of the embryo to represent the hypocotyl: *Zizania* (fig. 22, Pl. III), *Homalocenchrus* (fig. 28, Pl. IV), and *Spartina gracilis* (fig. 53, Pl. VI).

The scutellum has at every point where it comes in contact with the endosperm a layer of peculiar oblong cells called the epithelial layer. Sachs regards it as corresponding to the somewhat similar layer found in the cotyledons of the palms, and to the young epidermis of *Ricinus* and many other seeds. The scutellum, therefore, may be regarded as part of the cotyledon.

THE EPIBLAST.

The peculiar organ, the epiblast of Richard, situated opposite to the scutellum, is not very well understood. Its occurrence in the *Gramineæ* is of much greater frequency than is generally supposed. Warming[1] describes the fruit of the grasses, but does not mention the epiblast. He figures a fruit of *Avena sativa*, but does not represent the epiblast, which is always present and quite distinct. Van Tieghem[2] speaks of the existence of a second cotyledon in a dozen or less of the genera of

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[1] Warming and Potter. 1895.

[2] Comptes Rendus heb. Lean. l'Acad. des Sci. **124**: 1896 and 1897.

the *Gramineæ*. Unlike the scutellum, the epiblast has no vascular system, and on this account much dispute has arisen over its morphological nature. This, however, is no proof against its leaf nature, as there occur many instances of reduced organs without fibrovascular systems.

Although the epiblast is usually very small in comparison with the scutellum, yet there are many grasses in which it reaches a considerable size. *Zizania aquatica* (fig. 22, Pl. III) has a well-marked epiblast extending from the base of the lengthened axis to about the middle of the plumule, or even further.

In the genus *Stipa* there are marked differences in the size of the epiblast in the different species. *S. tenacissima* (fig. 30, Pl. IV) has a very small one; in *S. pennata* it is long and attenuated; while in *S. richardsonii* (fig. 36, Pl. V) and *S. viridula* (figs. 32 and 33, Pl. IV) it is very large and broad. Sometimes the margin of the epiblast is curved or deeply keeled, although in the large majority it is straight. *Homalocenchrus oryzoides* (fig. 28, Pl. IV) has a very large epiblast which greatly resembles the form of the scutellum. It is large and broad at the base and has a shield-like appearance. A small protuberance occurs at the base similar to that in the scutellum.

A fact which seems to indicate that the epiblast has the same morphological value as the scutellum is, that it is inserted on the axis almost at the same height. Even in *Zizania* (fig. 22, Pl. III), where the axis elongates to a great length and the insertion of the scutellum is almost at the base of the embryo, the epiblast is inserted directly opposite.

The absence or presence of the epiblast appears to be fairly constant in the different tribes, and the presence of an epiblast in a tribe where the majority of the genera have none may indicate that it is not in its natural position. The tribes *Andropogoneæ* and *Maydeæ*, to conclude from the genera examined, might be regarded as being without an epiblast. The scutellum almost entirely surrounds the embryo, as may be observed in any of the cross sections figured, more especially among the *Maydeæ*. In the tribe *Zoysieæ* there occur genera without an epiblast, as *Nazia*, *Trachys*, and *Anthephora*, while *Zoysia* has a distinct one. The *Tristegineæ*, to conclude from *Beckera* and *Arundinella*, have no epiblasts. The *Paniceæ* appear to be without an epiblast, the only exception being *Olyra*, which has a very large epiblast covering the plumule. From its great resemblance to the embryos of *Leersia* and *Oryza* it seems probable that it should be placed with them, or should form a separate intermediate tribe. The *Oryzeæ* appear to have a very large epiblast. The *Phalarideæ*, so far as examined, vary, *Anthoxanthum* and *Phalaris* having small epiblasts, while *Ehrharta* has none.

The *Agrostideæ* examined, although varying greatly in their external form, all possess an epiblast. In the large majority it is small, but in

some, as in *Stipa*, it is remarkably large, extending the whole length of the plumule. The *Aveneæ* also, so far as examined, all possess an epiblast. It is in the *Chlorideæ* that the most remarkable and varying formations of the embryo are to be found. *Eleusine* (fig. 52 A–D, Pl. VI) has a round nut-like fruit, with a small embryo having a very large epiblast; while *Spartina* (fig. 53, Pl. VI) has a long fruit, with the embryo extending almost the length of the seed, but with no trace of an epiblast. Between these occur the genera *Bulbilis* (fig. 58, Pl. VI), *Leptochloa* (fig. 56, Pl. VI), *Astrebla* (fig. 55, Pl. VI), *Cynodon* (fig. 57, Pl. VI), and *Beckmannia* (fig. 60, Pl. VI), each with an epiblast.

In the *Festuceæ*, a very large percentage of the genera have a well-formed epiblast, but in *Bromus* and some others it is absent. Among the *Hordeæ*, *Secale* (fig. 67, Pl. VII) and *Hordeum* (fig. 35, Pl. IV) are without an epiblast, while in *Lolium* (fig. 70, Pl. VIII) and *Triticum* (fig. 69, Pl. VII) it is present. *Elymus* (fig. 72, Pl. VIII) has a very light projection at the point where the epiblast is usually situated, and might be regarded as a transition stage between those with and those without an epiblast.

Among the *Bambuseæ* only the genera *Arundinaria* (figs. 74, 75, 76, Pl. VIII) and *Bambusa* have been examined. They possess very large broad epiblasts.

It appears, therefore, in most cases that the tribes *Maydeæ*, *Andropogoneæ*, *Zoysieæ*, *Tristegineæ*, and *Paniceæ* are without epiblasts, while in the *Oryzeæ*, *Phalarideæ*, *Aveneæ*, *Chlorideæ*, *Hordeæ*, *Festuceæ*, and perhaps, the *Bambuseæ*, it is usually present.

The following table will show that it is not correct to regard the epiblast as usually wanting in the Gramineæ.

MAYDEÆ.

Without epiblast.	*With epiblast.*
Euchlaena.	
Zea.	
Coix.	
Tripsacum.	

ANDROPOGONEÆ.

*Saccharum.[1]	
Andropogon.	
*Erianthus.	
Apluda	

ZOYSIEÆ.

Perotis.	Zoysia.
*Trachys.	Nazia.
Anthephora.	

[1] The genera starred (*) are taken from Bruns' work, not examined by the writer.

TRISTEGINEÆ.

*Arundinella.
*Beckera.

PANICEÆ.

Paspalum.
Pennisetum.
Chætochloa.
*Panicum.
Tricholæna.
*Pennisetum.
*Berchtoldia (Chaetium).
Cenchrus.

ORYZEÆ.

Oryza.
Zizania.
Homalocenchrus.
Lygeum.
Pharus.[2]

PHALARIDEÆ.

*Ehrharta.

Phalaris.
Anthoxanthum.
Savastana.

AGROSTIDEÆ.

Stipa.
Phleum.
*Polypogon.
Sporobolus.
*Piptatherum.
Calamagrostis.
Eriocoma.
Oryzopsis.
Brachyelytrum.
Ammophila.
Milium.
Chæturus.
*Apera.
Lagurus.
*Aristida.
Cinna.

AVENEÆ.

Avena.
Arrhenatherum.
Danthonia.
Aira.
Holcus.

[2] Van Tieghem. Ann. Sci. nat. Ser. 5, **15**: 240.

CHLORIDEÆ.

Spartina.	Leptochloa.
	Eleusine.
	Chloris.
	Beckmannia.
	Cynodon.
	Astrebla.
	Bulbilis.

HORDEÆ.

Secale.	* Nardus.
Hordeum.	Lolium.
Asperella.	Triticum.
	* Aegilops.
	* Lepturus.
	Elymus.

FESTUCACEÆ.

* Boissiera.	* Echinaria.
* Schismus.	Cynosurus.
Bromus.	Festuca.
Gynerium.	Leptochloa.
	Melica.
	Koeleria.
	Korycarpus.
	Desmazeria.
	Dactylis.
	Poa.
	Panicularia.
	* Lamarckia.
	* Avellinia.
	Briza.
	* Brachypodium.
	Triodia.

BAMBUSEÆ.

	Arundinaria.
	* Bambusa.

THE PLUMULE-SHEATH.

This peculiar structure is found in all grasses, completely surrounding and protecting the plumule, with the exception of a small opening or slit toward the apex on the side opposite to the scutellum. At germination the young leaves break through this sheath, which soon afterwards dies down. The plumule-sheath always has two distinct vascular bundles situated laterally and slightly inclined toward the scutellum. Considerable controversy has arisen as to whether this organ is a part of the cotyledon or whether it represents the first true leaf of the embryo. This will be treated of later under the chapter on the homology of the parts. It usually originates directly under the plumule and close to the insertion of the scutellum, although it is

widely separated from the scutellum in many grasses. See *Zizania* and *Homalocenchrus* (figs. 22 and 28, Pls. III and IV). Because of its thickness, it is specially adapted for a protective organ.

THE ROOT SYSTEM.

The large majority of the embryos of grasses have only one radicle, situated at the base of the embryo, usually in a vertical position, but sometimes turned obliquely, as in *Oryzopsis* (fig. 38A, Pl. V) and *Stipa richardsonii* (fig. 36, Pl. V), or, again, completely horizontal, as in *Eriocoma* (fig. 34, Pl. IV), *Oryza sativa* (fig. 27, Pl. IV), and *Eleusine* (fig. 52A–D, Pl. VI). In *Homalocenchrus oryzoides* (fig. 28, Pl. IV) it has a slightly upward tendency.

There are, however, embryos with numerous lateral roots. *Triticum æstivum* (fig. 69, Pl. VII) has four lateral roots, two on each side of the scutellum. *Zizania* (fig. 24O–Q, Pl. III) has three, situated directly under the plumule, a long distance from the main radicle. *Coix* (fig. 1, Pl. I) has four radicles, obliquely one above the other on the axis. In the illustration only three are seen, as they are not all in the same plane. *Hordeum vulgare* (figs. 65, 66, G and H, Pl. VII) has eight secondary radicles, three on each side of the scutellum and two in front. On germination the primary radicle is soon outstripped in growth by the secondary ones. Both the primary and secondary ones are surrounded by a compact mass of cells which form the coleorhiza or root-sheath.

Each radicle terminates in a rootcap, the cells of which appear as regular continuations of the rows of cells in the radicle. The rootcap can thus be distinguished from the coleorhiza, in which the cells are very irregular. The rootcap is not connected with the coleorhiza. The former is produced from the embryonic tissue, while the latter is derived from the preembryonic tissue and is connected with the lower part of the scutellum. In dissecting out the embryo the radicle or radicles, with their rootcaps, easily separate from the coleorhiza, leaving the latter at the base of the sockets in the lower part of the scutellum.

LATERAL BUDS.

In a number of genera of the tribe *Hordeæ* there is a lateral bud in the axil of the plumule-sheath: *Hordeum* (fig. 65, Pl. VII), *Triticum* (fig. 69, Pl. VII), *Elymus* (fig. 72, Pl. VIII), and *Secale* (fig. 67, Pl. VII). Bruns regards this as proving that the plumule-sheath must represent a leaf. Similar buds, however, may be found in Polygonum, Rumex, and a large number of plants with axillary stipules. Van Tieghem describes and figures lateral buds in *Avena sativa*, but it was not possible, after making many paraffin sections through different embryos, to discover them. This circumstance is remarkable, in that *Avena* belongs to the tribe *Aveneæ*, while all other genera in which lateral buds have been found belong to the tribe *Hordeæ*. Bruns, however, figures and describes a *Bambusa* with a large lateral bud in the axil of the plumule-sheath.

THE FIBRO-VASCULAR SYSTEM.

The fibro-vascular system of the embryos of the *Gramineæ* may be considered under three main divisions, according to the manner and place of insertion of the plumule-sheath on the axis and its connection with the scutellum.

1. The plumule-sheath is inserted on the axis directly above the insertion of the scutellum: *Stipa* (fig. 36, Pl. V), *Phleum* (fig. 41, Pl. V), *Ammophila* (Fig. 42, Pl. V), and perhaps all of the *Agrostideæ*.

An example of this modification occurs in *Stipa viridula* (figs. 32 and 33, Pl. IV). A vascular bundle passes through the entire length of the scutellum. At the insertion of this bundle on the axis two branches are sent off from it which traverse the plumule-sheath (fig. 33, Pl. IV), while the main branch continues into the axis and then descends to the radicle. A little above this insertion numerous small bundles form and run up into the young leaves and vegetation point. As these different bundles are not all in the same plane, it is not possible to obtain a single section showing them. In any transverse section of the plumule, however, the bundles of the plumule-sheath may be seen quite distinctly.

In *Eriocoma cuspidata* (fig. 34, Pl. IV) the bundles ascend from the axis into the plumule-sheath, while in a cross section of *Stipa richardsonii* (fig. 37 B, Pl. V), taken below the insertion of the scutellum on the axis, the vascular bundle may be seen entering the radicle. Again, in *Triticum* (fig. 69, Pl. VII) a bundle may be seen entering the first true leaf. *Hordeum* (fig. 65, Pl. VII) shows the bundles passing up into the second true leaf and the vegetation point, while several may be seen branching off from the axis into the secondary radicles. All the genera of the tribes *Agrostideæ* and *Hordeæ*, so far as examined, have this arrangement of their vascular systems.

2. The plumule-sheath is inserted on the axis at some distance from that of the scutellum, with which it is connected by a vascular bundle traversing the axis: *Zizania* (fig. 22, Pl. III) and *Homalocenchrus* (fig. 28, Pl. IV). The embryo of *Zizania aquatica* (figs. 22, 23 A and B, 24 A–T, Pl. III) has a remarkably long axis, which separates the insertion of the plumule-sheath and the scutellum to a very considerable degree. It will be noticed in the longitudinal section (fig. 22, Pl. III) that two vascular bundles traverse the axis, one terminating in the main radicle, while the other curves sharply round and traverses the long linear scutellum. The exceedingly large epiblast is devoid of any vascular system. In the transverse sections (fig. 24 A–T, Pl. III) it is found that in A, a section taken through the apex of the plumule-sheath, the two bundles have joined into one. In B they are beginning to separate, while in C and D they are entirely free. Figure E shows a section through the tip of the first leaf of the plumule, the plumule-sheath with its two widely separated lateral bundles surrounding it. Figures F–L illustrate sections taken through the plumule at different heights, showing the arrangement of the leaves with their bundles. The bundle in

the center of the leaf is always a little larger than the lateral ones. The bundle of the scutellum now appears distinctly in all sections taken through the region of the plumule. N represents a section taken directly underneath the plumule-sheath. The bundles of the sheath have united with those of the leaves and appear very irregular, with a secondary radicle appearing on each side. A little lower down a third secondary radicle is seen on the side of the axis next to the scutellum. The axis now for a considerable distance presents the appearance shown in P and Q, with two distinct, separate, vascular bundles in the center. At the base of the long axis one of these bundles situated nearest to the scutellum joins with the bundle of the latter, as in S, while the other continues down into the main radicle, as in T. This seems to prove conclusively that the plumule-sheath is not an independent leaf, but that it belongs to the scutellum.

There is no difference between this group and the first, represented by the *Agrostideæ*, except that between the insertion of the plumule-sheath and the scutellum there occurs a very long axis representing the first node.

3. The plumule-sheath is inserted on the axis at the base of the plumule, but its fibro-vascular bundles are not directly connected with that of the scutellum: *Zea*, *Coix*, *Pennisetum*, *Paspalum*, *Panicum*, and *Spartina*. *Zea mays* may be taken as typical of this arrangement of the vascular system, as shown by a series of sections from the radicle to the plumule (figs. 3, and 4 A–F, Pl. I). Fig. 4 A represents a cross section through the main, radicle. There are two systems of vessels, consisting of six large ones toward the center and about sixteen smaller ones on the outside, which, along with their conjunctive tissue, make up the central cylinder. Section B, taken somewhat higher up, above the region of coleorhiza shows the axis with its bundles beginning to form round the periphery of the central cylinder, the two systems of vessels remaining the same as in the radicle. The dark portions of the scutellum are sections through the lateral branches of the scutellum bundle. These peripheral bundles widen and come closer and closer to the center until they reach the condition figured in C, where there is an irregular mass of vascular strands and bundles with only a few of the vessels. Immediately above this the bundles arrange themselves round the periphery, leaving only a few in the center, while a vascular strand branches off and penetrates through the cortical parenchyma into the scutellum, where it divides into an ascending and descending branch, as in D. The large vessels have returned to their original position, while the smaller ones have become fewer, and are arranged irregularly nearer the center. At E, a section taken through the upper part of the scutellum, two radicles emerge from the axis to the right. Vascular bundles are found both in the periphery and in the center of the cylinder. The axis now continues in a regular form with its two systems of vessels and bundles arranged in the periphery,

until just below the plumule, where several bundles in the periphery unite on either side and branch off into the plumule-sheath. Soon numerous, bundles form in the center, until the whole axis is completely filled with them. These arrange themselves in a definite manner and run up into the leaves of the plumule.

There is no direct connection between the vascular bundle of the scutellum and those of the plumule-sheath, both originating from the peripheral bundles of the axis separately. The same condition occurs in all the genera of the *Maydeæ*, *Chlorideæ*, *Paniceæ*, and *Andropogoneæ* examined, with slight modifications as to the number and size of the vessels and bundles. This would seem to indicate that these tribes are closely related to one another, although it is not exactly in accordance with Hackel's classification of the tribes with reference to the *Chlorideæ*.

HOMOLOGY OF THE PARTS OF THE EMBRYO.

To what do the scutellum, epiblast, and plumule-sheath correspond; from what have they been developed; and to what parts of the leaf and spikelet of the grasses are they homologous?

The scutellum is at present generally regarded as the cotyledon, corresponding to the single cotyledon characteristic of the group of monocotyledons, but differing from them in not emerging from the caryopsis at germination.

The epiblast has been regarded in various ways by different authors. Bernhardi, Schleiden, Schacht, and, later, Van Tieghem, regard the epiblast as part of the cotyledon. Hanstein concludes that it is merely an insignificant trichomatic projection of the hypocotyl. The majority of writers, however, with Poiteau, Mirbel, and Bruns, regard it as a second rudimentary cotyledon, and in embryos in which it is wanting, look upon it as having become completely aborted.

Van Tieghem[1] in his new classification of the phanerogams based upon the ovule, revised his opinion concerning the epiblast, regarding it as a second rudimentary cotyledon, and explaining its partial or complete abortion as due to the pressure more or less exerted by the seed coat or pericarp upon the embryo. From this and other characters of the integuments and ovules he is led to believe that the *Gramineæ* are in reality dicotyledons, which have accidentally become monocotyledons.

In spite of the fact that there has never been found the slightest trace of a vascular system in the epiblast, yet it seems most reasonable to regard it as a second rudimentary cotyledon. One inclines to this view from the study of the perfectly developed epiblasts of *Homalocenchrus*, *Zizania*, and *Oryza*, where they are inserted on the axis opposite the insertion of the scutellum.

[1] Comptes Rendus seanc. l'acad. des Sciences, **124**: 1896–97.

The plumule-sheath is, of all the organs of the embryo, the most striking and difficult to explain. Three very different theories are held regarding its interpretation. To the first we attach the names of Hofmeister and Sachs, who regard it as an outgrowth of the so-called hypocotyledonary internode.

The adherents of the second view regard it as an independent leaf belonging to the plumule and next in leaf arrangement to the scutellum. According to this the plumule-sheath, which is directly above the scutellum on the same side of the axis, would not correspond to the distichous arrangement of grass leaves; but if one regards the epiblast as a leaf, i. e., a second cotyledon, then the apparent disagreement is explained and the plumule-sheath becomes the third leaf alternating with the epiblast. Bruns, who is a strong advocate of this view, sees no reason why Hanstein should deny the independent nature of the plumule-sheath because of its origin.

Let us briefly follow the devolopment of *Brachypodium* according to Hanstein's investigations. The young embryo is at first a spherical mass composed of three with sometimes a fourth smaller cell. These cells divide several times in all directions and the embryo takes on a club-shaped form, becoming longer and narrower at the base. This many-celled body is at this time without distinct internal or external differentiation. The lower-most cell, which has now become considerably divided, later goes to form the suspensor, while the two upper cells form the embryo proper. Soon the internal differentiation of the radicle can be seen with its dermatogen, periblem, and plerome. The second stage of development takes place in the external part of the embryo. In the wall there occurs a depression which marks the division of the scutellum from the hypocotyledonary part. The tissue immediately above this depression is the cotyledon, from which a part of the plumule-sheath soon emerges, while that on the lower side forms the vegetation point with its later-developed leaves. The projection on the upper part of the embryo, i. e., on the upper side of the depression, shows again on its upper surface another depression similar to the first, thus forming a second projection. At the same time a projection in the form of a half collar has formed on the lower part below the vegetation point. These two projections stand opposite one another like lips. Finally they grow and their margins unite to form a complete cap over the plumule. The occurrence of a slit in the mature plumule-sheath is in all probability caused by the incomplete junction of the margins of these collar-shaped projections. The tissue above this second depression, which sometimes curves down to a considerable degree protecting the plumule, forms that part of the cotyledon known as the cotyledonary-sheath. Thus the origin of the plumule sheath indicates that it must be a part of the scutellum. To regard the plumule-sheath as an independent leaf as Bruns has done, one must look upon it as arising from a stem and not from a primordial leaf, which, according to Hanstein's investigations, is evidently the case.

The third view is that the plumule-sheath is a ligule like growth proceeding from the scutellum as an inseparable part. The existence of an intermediate part between the insertion of the plumule-sheath and that of the scutellum in many embryos, is relied upon by Bernhardi, Bruns and others as positive proof that there can be no connection between these organs. By many authors it has been called an internode, which latter always develops between two leaves and not between two parts of a leaf.

Bruns says that while in *Euchlæna* the two insertion points are near together, it hardly seems plausible in the case of *Spartina*, and especially of *Zizania*, to regard two organs which are so widely separated from one another as the same. The occurrence of a bud in the axil of the plumule-sheath also influences his conclusion that the plumule-sheath must represent a leaf.

From a careful study of the vascular system of the different tribes, together with Hanstein's investigations, one is led to believe with Van Tieghem and Celakovsky that the so-called internode between the plumule-sheath and the scutellum, occurring so distinctly in *Zizania* and *Homalocenchrus*, and not at all in the genera of the *Agrostideæ*, is nothing but the first unusually lengthened node. The ligule-like growth, the plumule-sheath, is usually inserted directly over the scutellum, but sometimes the axis stretches itself between the insertion of the scutellum and the plumule-sheath as in the mature fruits of *Zizania*, *Homalocenchrus*, the *Chlorideæ*, or as in *Oryza* (according to Bruns and Schlickum) soon after germination.

The vegetative leaf of the grasses is composed of a sheath and blade and a more or less strongly developed ligule inserted at the point of junction of the sheath and blade. The ligule is usually small, without chlorophyll and stomata, and exclusively parenchymatous, but as Duval-Jouve[1] has shown in *Ammophila arenaria*, it attains a length of about 4 centimeters and possesses nerves with chlorophyll and stomata. The ligule thus represents a double sheathing axillary stipule.

Of the three parts of the leaf it is the sheath which develops last, by an intercalary growth, which raises up the blade and ligule.

Comparing the culm leaf with the scutellum and plumule-sheath, the cotyledonary leaf of the embryo, one finds that the latter has no sheath. Its sessile blade, however, elongates to form the scutellum, while the pumule-sheath, which is homologous with the ligule, attains a great size with vascular bundles similar to the ligule of *Ammophila arenaria*. It is provided with two prominent lateral nerves, which later acquire chlorophyll and stomata.

The homology of the parts may in the same manner be carried out in the spikelet. The awn of the floral glume, when present, is regarded as corresponding to the blade of the leaf, and therefore to the scutellum of the embryo. When the awn is inserted on the back of the

[1] Anatomie de l'arete des Graminees Mem. de l'ac. des Sci. et lettres. Montpellier. 1871.

glume some distance from the apex, that part between the insertion and the apex is regarded as corresponding to the ligule, and, in consequence, to the plumule-sheath. That part of the glume below the insertion of the awn is regarded as the sheath of the leaf, while its analogous structure in the embryo has been arrested in its development.

Colomb,[1] who has investigated the stipules of many plants, also takes up the ligule and sees in it an analogy to the stipules of *Potamogeton* and *Smilax*. Celakovsky[2] makes a comparison between these, adding another plant, *Ficus elastica*. He carries his homology still further to the mosses, believing that the moss capsule is homologous to the cotyledon and the seta or their bases to the hypocotyl.

DETAILED DESCRIPTIONS OF FRUITS.

Tribe MAYDEÆ.

The fruits of the genera of this tribe are large, ellipsoidal or roundish, and inclosed, with the exception of *Zea*, in a hard capsule formed of the glumes or of part of the articulate rachis. They have a very large embryo, with the scutellum almost completely surrounding the plumule.

Coix lachrymæ-jobi L. (figs. 1, 2 A–G, Pl. I). The structure of the embryo of *Coix* resembles that of *Zea mays*, the main difference consisting in the former possessing four lateral radicles. Only three are shown in fig. 1, the fourth and uppermost one not being in the same plane. Fig. 2 A represents a transverse section through the upper part of the plumule, showing the plumule-sheath with its two bundles and the first and second true leaves in their normal position. A section through the base of the plumule (fig. 2 B) shows the plumule-sheath and a small part of the first, true leaf. Within is the axis with its numerous bundles which belong to the leaves of the plumule.

At C is the axis, with its numerous bundles and the plumule-sheath. Some of the bundles in the periphery of the central cylinder unite and branch off into the plumule-sheath on each side. A little lower down, between the insertion of the plumule-sheath and that of the scutellum the axis appears with its numerous bundles arranged in the periphery of the central cylinder (fig. 2 D). Fig. 2 E shows the scutellum inserted on the axis by its broad, fibro-vascular bundle, at the same time cutting through the first lateral radicle on the opposite side. A number of ducts are scattered here and there in the axis. The axis terminates in the lowermost radicle, the central cylinder having six distinct ducts or vessels. Fig. 2 F shows a section through the upper part of the lowermost radicle and one of the lateral radicles, while G represents a section through the lowermost radicle. Each radicle is provided with a root-cap while the coleorhiza surrounds them all. The

[1] Recherches sur les stipules. Ann. des Sci. nat. Ser. 6, **1**: 19. 1887.

[2] Ueber die Homologien des Grasembryo. Bot. Zeit., Sept., 1897.

scutellum entirely surrounds the remainder of the embryo, as may be seen in cross section or in the longitudinal section (fig. 1). There does not appear to be such a direct connection between the vascular bundle of the scutellum and those of the plumule-sheath, as in *Zizania* (fig. 22, Pl. III), *Homalocenchrus* (fig. 28, Pl. IV), and other embryos. The vascular bundle of the scutellum, as in the other genera of the *Maydeæ*, branches into two, one traversing the upper and the other the lower part of the scutellum, and these again sending off lateral branches. The leaves of the plumule are arranged as in all grass embryos.

Zea mays L. (figs. 3, 4 A–F, Pl. I).—The vascular system of *Zea* has already been described. The general structure of the embryo differs but little from that of *Coix*. Instead of four large lateral radicles it has one large main radicle (fig. 4 A) and two smaller secondary ones at the insertion of the scutellum bundle on the axis. The scutellum surrounds the remainder of the embryo like a mantle, the margins almost coming together, but separated by a long, narrow groove (figs. D and E). There is a deep cleft between the base of the scutellum and the coleorhiza (fig. 3).

Tripsacum dactyloides L. (figs. 5, 6, 7, A–B, Pl. I).—The embryo of *Tripsacum* is very similar to that of *Zea* and *Coix*, except that it has only one radicle. The axis is remarkably long and consists of a number of vascular bundles, as in *Coix*. About halfway down the axis the bundles in the periphery increase toward the center, presenting the same condition as in *Coix* and *Zea*, again returning to the periphery and disappearing as they approach the radicle. The insertion of the scutellum-bundle is not as in *Coix*, *Zea*, and *Euchlæna* at some distance from the plumule but directly under it, where the plumule-sheath also branches off (fig. 6). The scutellum-bundle soon after leaving the axis divides, one branch traversing the lower, and the other the upper part of the scutellum, while these in turn have lateral branches (fig. 6). Aside from these bundles connected with the vascular system there are conducting vessels running irregularly through the scutellum, apparently nourishing organs for the plumule and radicle, as they can be traced to be directly connected through the epithelial layer with the other parts of the embryo (fig. 6).

Euchlæna mexicana Schrad. (fig. 8, Pl. II).—The structure of the embryo of *Euchlæna* is almost identical with that of *Zea mays*, except that it has no secondary radicles and the insertion of the scutellum-bundle is at some distance from the plumule.

Tribe ANDROPOGONEÆ.

The fruits of the tribe *Andropogoneæ* have an embryo which is usually about half the size of the fruit itself. As in the *Maydeæ*, the scutellum almost completely surrounds the remainder of the embryo. By comparing the embryo of *Andropogon* (fig. 9, Pl. II) with *Zea* (fig. 3, Pl. I) one notices a striking similarity. The scutellum-bundle is inserted on

the axis at some distance from the plumule, as in the majority of the *Maydeæ.*

Andropogon saccharatus (fig. 9, 10, A–C Pl. II).—The scutellum almost surrounds the plumule. The projection appearing in fig. 9 like an epiblast is only a longitudinal section through one of the margins of the scutellum. The scutellum-bundle is inserted on the axis at some distance from the plumule, while directly under the plumule two bundles branch off into the plumule-sheath. Fig. 10 A shows a section through the plumule with its plumule-sheath and bundles of the first true leaf, while fig. 10 B represents a section taken through the axis between the plumule and the insertion of the scutellum-bundle. Only one radicle is present with a large vessel in the center and five smaller ones around it in the central cylinder (fig. 10 C). There is a deep groove between the scutellum and the coleorhiza.

Apluda cristata (figs. 11, 12, Pl. II).—The embryo of *Apluda cristata* resembles those of the *Maydeæ* and *Chlorideæ.* There is no epiblast. The radicle appears as in fig. 12, with one large vessel and six smaller ones in the central cylinder. This arrangement continues through the axis until near the insertion of the scutellum, where vascular bundles appear. These continue through the lengthened node as far as the base of the plumule, where they send off branches into the plumule-sheath. The ring around the radicle in fig. 12 represents a cross section through the coleorhiza.

Tribe ZOYSIEÆ.

The *Zoysieæ* resemble on the one hand the *Andropogoneæ*, through *Trachys*, *Anthephora* (fig. 13 A–E, 1 Pl. II), and *Perotis* (fig. 15 A–D), and on the other hand *Oryzeæ* through *Zoysia* (fig. 14 A–D) and *Nazia.* Bruns, in a list of genera, represents *Nazia* without an epiblast, while in his figures he represents it with an epiblast, both in longitudinal and transverse sections. The scutellum in *Anthephora* and *Perotis* is inserted at some distance from the plumule, while in *Zoysia* it is inserted directly under it. The radicle of *Zoysia* is also curved in a horizontal direction like *Oryza.*

Tribe TRISTEGINEÆ.

Unfortunately no representatives of this tribe could be secured. Bruns, however, who has investigated the fruits of *Beckera* and *Arundinella*, found them to be without an epiblast, and similar to the *Zoysieæ.*

Tribe PANICEÆ.

The general appearance of the fruits of the *Paniceæ* is similar to those of *Andropogoneæ.* They are, with one exception, without an epiblast, and have the scutellum-bundle inserted at some distance from the plumule. *Olyra* is the only genus which has an epiblast. It is

described and figured by Bruns, and differs in every respect from the other *Paniceæ*. The scutellum is broader than long, while the plumule is covered by a very large epiblast. A peculiarity mentioned by Bruns is that the radicle is hollowed out. Owing to the general appearance of the fruit and embryo, with its large epiblast and the insertion of the scutellum-bundle, also the fact that the flower is monœcious, would seem to indicate that it does not belong to the *Paniceæ*. It might, perhaps, be placed with the *Oryzeæ* or form an intermediate tribe with *Zoysia* between the *Paniceæ* and *Oryzeæ*.

Pennisetum spicatum (figs. 16, 17, 18, Pl. II).—The fruit of *Pennisetum* has a very large embryo. The scutellum surrounds the remainder of the embryo, although not to such an extent as in the *Andropogoneæ* and *Maydeæ*. The projection opposite the scutellum in fig. 16 is not an epiblast, but a longitudinal section through the margin of the scutellum. A single large radicle is present, which consists of one large vessel in the center and six small ones surrounding it in the central cylinder (fig. 18). The ring around the radicle represents the coleorhiza with its attachment to the scutellum. Fig. 17 represents a cross section through the plumule, showing the scutellum with its bundle and the plumule-sheath with its two lateral bundles. Within is the first true leaf. The scutellum-bundle is inserted on the axis at some distance from the plumule (fig. 18).

Chætochloa macrochæta (fig. 19, Pl. III).—The embryo of this nut-like fruit resembles in the main other *Paniceæ*. The insertion of the scutellum-bundle is, however, somewhat closer to the plumule. A deep cleft or groove is present between the scutellum and coleorhiza.

Paspalum pubiflorum glabrum (figs. 20, 21, Pl. III).—The embryo of *Paspalum* resembles that of *Pennisetum*, although much smaller. It possesses a large radicle, and its scutellum-bundle is inserted at some distance from the plumule.

Tribe ORYZEÆ.

To this tribe belong, among others, the genera *Homalocenchrus*, *Zizania*, and *Oryza*. Great variation occurs in the size and formation of the fruits. The embryo is usually small compared with the amount of endosperm, but in *Zizania* it attains a considerable size. All the genera belonging to this tribe have a well-marked epiblast.

Zizania aquatica (figs. 22, 23 A–B, 24 A–T, Pl. III) (see p. 21).—The fruit of *Zizania* is long and linear, with an epiblast which reaches three-quarters the length of the whole fruit. Figs 23 A and B show the relative size of embryo and endosperm; A through the plumule, and B through the axis or lengthened node. Figs. 24 A–T represent a series of sections through the embryo from the apex of the plumule-sheath to the main radicle. A and B show the two vascular bundles of the plumule-sheath, which at this point are united into one. At C and D they have become separated, while at E the plumule-sheath appears as

a complete ring, inclosing the upper part of the first leaf. The opening in the plumule-sheath on the side opposite to the scutellum now appears for a short distance as shown at G. At H, I, and J it is again closed, and within is seen the arrangement of the leaves of the plumule. K shows the first appearance of the epiblast, while at M it has increased in size. Within the plumule-sheath and first leaf one sees the axis with its bundles which belong to the remaining leaves of the plumule. Immediately below the plumule are three secondary radicles represented in N and O. The embryo for a considerable distance presents a form similar to that shown at P. The vascular system in the region of the secondary radicles presents a confused mass, but here it consists of two regular strands which course the lengthened node. As they approach the insertion of the scutellum the inner one becomes larger until it unites with the bundle of the scutellum. R shows the attachment of the epiblast to the axis, the division being marked by a dotted line, while T is a section through the main radicle surrounded by its coleorhiza.

Homalocenchrus oryzoides (fig. 28, Pl. IV).—The fruits of *Homalocenchrus*, although much smaller and of a different form from that of *Zizania*, yet in the main possess the same structural characters of the embryo.

Lygeum spartum (figs. 25, 26 A–E, Pl. IV).—The embryo of *Lygeum* differs from the other genera of the *Oryzeæ* examined in having a very small epiblast. The insertion of the scutellum-bundle occurs directly beneath the plumule. Also at this point branches are sent off into the plumule-sheath (fig. 26 B). The radicle is here lengthened out to a considerable extent. Lateral roots also arise from the node, as in fig. 26 C and D. Fig. 26 E shows a section through the main radicle, while 26 C shows parts of the secondary radicles and the base of the epiblast.

Oryza sativa (fig. 27, Pl. IV).—Compared with the amount of endosperm, *Oryza* has a very small embryo. The epiblast is large and broad at the base. As in *Lygeum*, the insertion of the scutellum is at the base of the plumule. The large radicle is directed obliquely outward.

Tribe PHALARIDEÆ.

Of the *Phalarideæ* only *Phalaris* and *Anthoxanthum* (fig. 29, Pl. IV) were examined. These much resemble the *Agrostideæ*, having a small epiblast and a straight radicle. The scutellum-bundle is inserted at the base of the plumule-sheath.

Tribe AGROSTIDEÆ.

The *Agrostideæ* may be characterized as fruits with small embryos, always with an epiblast, which, however, varies greatly in size. The scutellum-bundle is inserted on the axis at the base of the plumule. Here it branches to the right and left, running up into the plumule-

sheath. The short axis terminates in a single radicle. Among the peculiarities noticed in this tribe is the genus *Stipa*. *Stipa pennata* has a well-marked epiblast more than half the length of the plumule, while *S. tenacissima* (figs. 30 and 31, Pl. IV) has a very small epiblast. In fig. 31 the opening of the plumule-sheath is apparent. In *Stipa richardsoni* (figs. 36 and 37 A and B, Pl. V) the epiblast extends more than half the length of the plumule, and the radicle is directed obliquely outward. Although *S. viridula* (figs. 32 and 33, Pl. IV) has a very small fruit, yet its embryo has proportionately the largest epiblast.

Eriocoma cuspidata (figs. 34 and 35, Pl. IV).—The fruit of *Eriocoma* resembles that of *Oryzopsis*, but has a very large epiblast which extends the whole length of the plumule. The scutellum differs from *Oryzopsis* in having a groove at its base. This character, together with the long, densely hairy, flowering glumes, would warrant its being placed as a separate genus *Eriocoma*, which is regarded as a subgenus by Hackel.

Oryzopsis micrantha (figs. 38 A and B, Pl. V), *Phleum pratense* (fig. 41, Pl. V), *Cinna arundinacea* (figs. 39 and 40, Pl. V), and *Brachyelytrum erectum* (fig. 43, Pl. V) all have a well-marked epiblast. The last named can easily be recognized by a long, pointed projection proceeding from the pericarp. This projection contains no starch, and its presence is remarkable from the fact that it is the only fruit in which such a structure has been found. *Ammophila arenaria* (fig. 42, Pl. V) presents a peculiar appearance. Its cotyledonary sheath extends down to the apex of the plumule. The scutellum also branches into three in the upper part.

Tribe AVENEÆ.

The *Aveneæ* resemble the *Hordeæ* in the structure of fruits. The embryo is usually small compared with the amount of endosperm. Lateral roots occur in *Avena*. The scutellum-bundle is inserted at the base of the plumule and continues down into the axis in the form of a loop.

Avena sativa (figs. 44, 45, 46 A–B, 47 A–G, 48, Pls. V and VI).—Fig. 47 A–G, Pl. V, represents a series of transverse sections through the embryo from the plumule to the radicles. At A one sees the peculiar shape of the scutellum, with its vascular bundle, while within is the plumule-sheath, with its bundles, inclosing the first true leaf. B represents a section taken somewhat lower down in the plumule and shows the position of the second leaf directly opposed to the first. The scutellum-bundle branches at the base of the plumule, as may be seen at C, to form the bundles of the plumule-sheath. Part of the plumule-sheath is still present, while within is the axis with the first leaf and its bundles just beginning to differentiate. Figs. D, E, and F show the axis, and the epiblast which becomes larger toward the base. At E only one radicle is present while at F there are three. G shows the position of the four radicles. The main radicle is in the center with one on each side to the right and left, and a fourth smaller one in front.

A longitudinal section of this small radicle may be seen in fig. 48, Pl. VI. The scutellum-bundle forms a loop in the axis as in fig. 48, a strand branching off from it forms the central bundle of the first true leaf. Fig. 45, Pl. V, represents a section facing the embryo. The main radicle with its two lateral radicles to the right and left are all surrounded by a coleorhiza. Figs. 44 and 46 A and B, Pl. V, represent longitudinal and transverse sections through the whole fruit showing the relative size of endosperm to embryo.

Holcus lanatus (fig. 51, Pl. VI.), *Arrhenatherum elatius* (fig. 49), and *Danthonia spicata* (fig. 50) all have a small epiblast and a single terminal radicle with the scutellum-bundle inserted directly under the plumule.

Tribe CHLORIDEÆ.

The *Chlorideæ*, according to the characters of their embryos, are more closely allied to the *Andropogoneæ* than to the *Aveneæ* and *Festuceæ*, with which they are placed in Hackel's classification. The fruit varies considerably both in regard to its form and the structure of the embryo. There is a spherical nut-like fruit, as in *Eleusine* (fig. 52 A–D, Pl. VI), with a well-marked epiblast, and a long linear fruit with an embryo more than half the size of the fruit itself and without an epiblast, as in *Spartina gracilis* (fig. 53). The scutellum is inserted on the axis at some distance from the plumule.

Eleusine coracana (fig. 52 A–D, Pl. VI).—This peculiar nut-like fruit has an embryo with a very large epiblast. The radicle is in a horizontal direction, while a deep groove is present between the scutellum and coleorhiza. The insertion of the scutellum-bundle is close to the base of the plumule, while the axis between the plumule and radicle is very short. Fig. 52 A represents a longitudinal section through the embryo, while at B we see the plumule with the large epiblast protecting it.

Spartina gracilis figs. 55, 54 A–C, Pl. VI).—In contrast to *Eleusine* it has a long linear fruit with an embryo reaching almost its whole length. The general appearance of the embryo reminds one of *Zizania aquatica*, as the insertion of the scutellum is a considerable distance from the plumule-sheath. One single vascular strand courses the lengthened node until it sends off a branch to the scutellum, and then continues down into the very small radicle. Fig. 54 A, B, C show sections through the radicle, lengthened node, and plumule, respectively. It is a noteworthy fact that this is the only genus of the *Chlorideæ* examined which does not have an epiblast.

Astrebla pectinata (fig. 55, Pl. VI).—The embryo of *Astrebla* is very large, with a very small epiblast. A deep groove is present between the scutellum and the coleorhiza. The scutellum-bundle is inserted on the axis at some distance from the plumule. The axis terminates in a single radicle, which preserves its root structure until just before it reaches the insertion of the scutellum, where vascular bundles appear.

Beckmannia erucæformis (fig. 60, Pl. VI), *Bulbilis dactyloides* (figs. 58 and 59, Pl. VI), and *Leptochloa imbricata* (fig. 56, Pl. VI) have about the same characteristics.

Tribe FESTUCEÆ.

The embryo of the *Festuceæ* is usually small. There is, according to Bruns, great variation in the presence and absence of an epiblast in this tribe.

Uniola latifolia (fig. 61, Pl. VII).—A broad epiblast reaches about half the length of the plumule. The scutellum-bundle is inserted on the axis at some distance from the plumule, while the single radicle is turned obliquely outwards.

Desmazeria sicula (fig. 63, Pl. VII), *Cynosurus cristatus* (fig. 64), and *Panicularia aquatica* (fig. 62, Pl. VII) all have the epiblast well marked. The scutellum-bundle differs from that of *Uniola* in being inserted directly at the base of the plumule. The axis terminates in a single radicle.

Tribe HORDEÆ.

The tribe *Hordeæ* may be characterized as having large fruits. The embryo usually has several radicles and a lateral bud in the axil of the plumule-sheath. A transition seems to take place between those without an epiblast, as in Hordeum (fig. 65, Pl. VII), and those with a distinctly formed epiblast as in *Triticum* (fig. 69, Pl. VII).

Hordeum vulgare (fig. 65, 66 A–H, Pl. VII). The fruit of *Hordeum vulgare* has many peculiarities not found in other grasses. There are two, and in some parts three, layers of gluten cells, while in nearly all grass fruits there is only one. This embryo often has, besides its main radicle, eight secondary ones, three on each side of the scutellum and two in front. In the axil of the plumule-sheath next the scutellum there is a large lateral bud (see p. 20). By examining figs. A–F it will be seen that the scutellum-bundle is composed of two strands which unite just before their insertion on the axis. The scutellum is inserted on the axis at the base of the plumule, a secondary radicle also emerging from it at this point, thus making the axis very short. At fig. 65 the bundles may be seen which belong to the first and second leaves and the vegetation point. Those of the plumule-sheath not being in the same plane are not represented. A transverse section through the upper part of the plumule (fig. 66) shows the opening in the sheath opposite to the scutellum and the two bundles situated laterally. Within is the upper part of the first true leaf. The scutellum shows a peculiar groove on its convex side next to the endosperm (fig. 66, A, B).

B shows a similar condition a little lower down through the plumule. At C and D the position of the first leaf opposite to the plumule-sheath, the second opposite the first, and the third opposite the second, according to the true distichous arrangement of all grass leaves may be noted.

E shows a section taken at the base of the plumule with the bundles in the axis which belong to the leaves of the plumule, also the two bundles of the disappearing plumule-sheath. At F the scutellum bundles are inserted on the axis. On the opposite side are two secondary radicles in the center of the bundles of the axis, while to the right and left appear the origin of the bundles of the plumule-sheath. At C the scutellum-bundles are no longer present, while three secondary radicles emerge from the axis. Four of the secondary radicles may be seen at H with the axis continuing down to form the main radicle. These radicles are all provided with a root-cap and surrounded by the coleorhiza. Although no epiblast is found here yet there is a slight prominence which might indicate its abortion.

Secale montanum (figs. 67, 68 A and B, Pl. VII).—The structure of the fruit of *Secale* resembles that of *Hordeum vulgare*. There is however only one secondary radicle. Not even a trace of an epiblast can be seen. The coleorhiza surrounds both radicles, forming a deep groove between them. At the base of the plumule-sheath next to the scutellum there is a lateral bud. The scutellum-bundle consists of a single strand, which is inserted on the axis almost directly at the base of the plumule. At this point branches are sent off into the plumule-sheath. The bundles in the axis belong to the leaves of the plumule while the axis continues down into the main radicle, a branch being sent off to the secondary radicle. Fig. 68 B represents a transverse section through the upper part of the plumule and A through the main and secondary radicles.

Elymus virginicus (figs. 72 and 73, Pl. VIII).—The fruit of *Elymus* has a very small embryo at the base of a long fruit. Although the epiblast is not present yet there is a slight elevation which might be regarded as a remnant of it. The scutellum bundle consists of a single strand which curves around to the base of the plumule where it divides into three branches, two of them going into the plumule-sheath and the other continuing down into the axis and single radicle. A lateral bud is present in the axil of the plumule-sheath. Fig. 73 represents a transverse section through the upper part of the plumule.

Lolium rigidum (figs. 70, 71 A–C, Pl. VIII).—The embryo of *Lolium* resembles *Secale montanum* with only one large radicle. A lateral bud is present in the axil of the plumule-sheath.

Triticum æstivum (fig. 69, Pl. VII).—The fruit of *Triticum æstivum* has been so frequently described by previous writers that it is not necessary to treat it at length here. An excellent treatise by Bessey is to be found in Bull. 32 of the Nebraska Agr. Exp. Station, 1894. Its embryo has a small epiblast, a main radicle, and two secondary ones situated in front to the right and left. There is a prominent lateral bud in the axil of the plumule-sheath. In all other respects it resembles the tribe *Hordeæ*.

Tribe BAMBUSEÆ.

A small plant of *Arundinaria falcata* bloomed in the Cornell nursery during the summer of 1898. About a dozen fruits were secured and sections of the embryo made.

The fruit is oval and is covered by a pericarp, which easily separates from the endosperm and embryo. The embryo is small, with its scutellum almost completely surrounding the plumule (fig. 74, Pl. VIII). The vascular bundle traversing it is branched in all directions, as shown in any of the transverse sections (fig. 76 A–J, Pl. VIII).

The plumule-sheath differs from all other fruits of the *Gramineæ* investigated in having five vascular bundles instead of two. At its apex there is a well-marked slit or opening and only two vascular bundles (fig. 76 C). Figs. 76 D, E, F show the position of the five vascular bundles inclined toward the exterior side of the embryo.

The leaves have seven vascular bundles and are arranged as in all grass embryos (fig. 76 E). The epiblast is large and broad, but does not extend far up on the plumule. Toward the base it is rectangular in cross section (fig. 76 G, H). The axis terminates in one large radicle (fig. 76 K).

RELATIONSHIP AND SYSTEMATIC CONNECTION OF THE TRIBES.

Botanists disagree very generally as to which are the most primitive tribes of the grasses. The three great authorities on the subject are Hackel,[1] Bentham,[2] and Warming.[3] Their classifications are as follows:

BENTHAM'S CLASSIFICATION.

A. Panicaceæ.	*B. Poaceæ.*
Tribe I. Paniceæ.	Tribe VII. Phalarideæ.
II. Maydeæ.	VIII. Agrostideæ.
III. Oryzeæ.	IX. Isachneæ.
IV. Tristegineæ.	X. Aveneæ.
V. Zoysieæ.	XI. Chlorideæ.
VI. Andropogoneæ.	XII. Festuceæ.
	XIII. Hordeæ.
	XIV. Bambuseæ

HACKEL'S CLASSIFICATION.

A. Panicaceæ.	*B. Poaceæ.*
Tribe I. Maydeæ.	Tribe VII. Phalarideæ.
II. Andropogoneæ.	VIII. Agrostideæ.
III. Zoysieæ.	IX. Aveneæ.
IV. Tristegineæ.	X. Chlorideæ.
V. Paniceæ.	XI. Festuceæ.
VI. Oryzeæ.	XII. Hordeæ.
	XIII. Bambuseæ.

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[1] Hackel, E. Echte Græser. Engler and Prantl, Pflanzenfamilien, **2**[2]: 2. Eng. trans. by Scribner and Southworth, 1890.

[2] Bentham, Geo. "Notes on Gramineæ," Jour. of the Linn. Soc., **19**: 14–134, 1881–82.

[3] Warming, E., and Potter, C., Systematic Botany.

WARMING'S CLASSIFICATION.

Tribe	I. Bambuseæ.	Tribe	VII. Agrostideæ.
	II. Oryzeæ.		VIII. Phalarideæ.
	III. Maydeæ.		IX. Chlorideæ.
	IV. Andropogoneæ.		X. Paniceæ.
	V. Festuceæ.		XI. Hordeæ.
	VI. Aveneæ.		

It will be noticed that Hackel's arrangement is in the main similar to that of Bentham, while Warming's varies, omitting the tribes *Zoysieæ* and *Tristegineæ*. Bentham, on the one hand, regards the tribes *Paniceæ*, *Maydeæ*, and *Oryzeæ*, while on the other, Hackel places the *Maydeæ*, *Andropogoneæ*, and *Zoysieæ* as the most primitive of the grasses. Warming, however, presents an entirely different view, and regards the *Bambuseæ* and *Oryzeæ* as the most primitive.

This great difference of opinion is probably due to the fact that the grasses have been largely studied from the basis of only a single character. Hackel[1] claims to have discovered the magic spell by which all difficulties must come to an end in regard to the arrangement of the genera of the *Andropogoneæ*, but it is to be doubted whether the same can be said of his arrangement of the tribes. The *Andropogoneæ* together with the *Maydeæ*, *Paniceæ*, *Tristegineæ*, and *Zoysieæ* without doubt represent a very natural group of the *Gramineæ*, but it is a question whether they are the most primitive. If one studies the *Andropogoneæ* from the standpoint of their resemblance to other Monocotyledons one is unable to find the slightest trace of such resemblances in any of the genera, while among the *Bambuseæ* and *Oryzeæ* there are many similarities.

The *Bambuseæ* are characterized as large, often tree-like, grasses, with woody, rarely herbaceous culms. The leaves are broad, sometimes compound and usually petioled. There are from three to six, or many, stamens while the prevailing number in the other *Gramineæ* is two or three. Usually three remarkably large lodicules[2] are present on the rhachilla. There is great variation in the structure and in the form of the fruit. Both Munro[3] and Hackel[4] use fruit characters to divide the different genera into sections. They may be classified as the berry-bearing and the true bamboos, the latter with linear or oblong-linear fruits, like those of *Avena* and *Triticum*, with a distinct furrow down one side and the scutellum visible below.

In the berry-bearing bamboos the caryopsis appears to be contained in an envelope somewhat analogous to the sac or perigynium which incloses the seed of *Carex*. In *Melocanna bambusoides* this covering

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[1] Hackel, E., Andropogoneæ. De Candolle's Monographie Phaner.

[2] Rowlee, W. W. The Morphological Significance of the Lodicules of Grasses. Bot. Gaz. **25**: 199–203. 1898.

[3] Munro, Memoir on Bambuseæ. Trans. of the Linn. Soc. XXVI:

[4] Hackel, E., Echte Græser. Engler and Prantl, Pflanzenfamilien, II[2]: p. 92. Eng. trans. by Scribner and Southworth.

becomes very fleshy and the fruit attains the size of a large pear. *Schizostachyum acutiflorum* has very curious bundles of hairs on the scutellum, and the pericarp of the oblong fruit is quite loose and rugose. Some of the genera of the section *Triglosseæ* approach very closely in the structure of the spikelet the tribe *Paniceæ*.

The *Oryzeæ* may be compared with the *Bambuseæ*. In regard to their leaves there is a great variety of forms, from broad, ovate, petiolate leaves in *Pharus*, to long, linear ones in *Zizania*, and short, narrow leaves rounded at the apex in *Hydrochloa*. There is also great variation in the inflorescence. In some of the genera a number of bracts are arranged spirally around the main axis, while in others the inflorescence is inclosed in a spathiform envelope. The normal number of stamens is six, although they vary from one to eight. The pistil usually branches into two plumose stigmas, with occasionally a three-branched style, as in *Pharus*. The lodicules vary from 2 to 3. There are long, linear fruits, as in *Pharus*, and oblong-linear fruits, as in *Oryza*. The *Oryzeæ* therefore resemble the *Bambuseæ* in the following respects: (1) They show great variation in the structure of their fruit and spikelet. (2) Both have remarkably large epiblasts. (3) Some genera have the same number of lodicules. (4) *Pharus* has a style with three stigmas. (5) Many of the genera have broad petiolate leaves and transitions between these to linear ones. (6) They have to a great extent the same geographical distribution, the larger number of the genera being indigenous to tropical America. It would appear therefore that the *Oryzeæ* are closely related to the *Bambuseæ*, and that together they represent the most primitive of the grasses, thus bringing them nearer to the other Monocotyledons (e. g., *Palmaceæ*). So far as it has been observed there appears to be no similarity between the *Bambuseæ* and *Hordeæ*, although they are looked upon by both Bentham and Hackel as being closely allied.

The *Zoysieæ*, *Tristegineæ*, *Andropogoneæ*, *Maydeæ*, and *Paniceæ*, both according to the characters of the fruit and those of the inflorescence, according to Hackel's classification, form another natural group, joined to the *Oryzeæ* through the *Zoysieæ* and *Tristegineæ*. The *Chlorideæ*, although regarded by both Hackel and Warming as being removed some distance from the *Andropogoneæ*, are like them in their fruit characters.

The remaining tribes, *Phalarideæ*, *Agrostideæ*, *Aveneæ*, *Festuceæ*, and *Hordeæ*, from their fruit characters, form another group in the order named, which corresponds with the classification given by Hackel.

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EXPLANATION OF PLATES.

PLATE I.

FIG. 1. *Coix lachrymæ-jobi*, long. sec.; (x 7).
2 A–D. *Coix lachrymæ-jobi*, cross sec. of embryo; (x 9).
3. *Zea mays*, long. sec. of embryo; (x 5).
4 A–F. *Zea mays*, cross sec. of embryo; (x 14).
5. *Tripsacum dactyloides*, long. sec. facing embryo; (x 8).
6. *Tripsacum dactyloides*, long. sec.; (x 8).
7 A and B. *Tripsacum dactyloides*, cross sec.; (x 8).

PLATE II.

8. *Euchlæna mexicana*, long. sec. of embryo; (x 23).
9. *Andropogon saccharatus*, long. sec.; (x 19).
10 A–C. *Andropogon saccharatus*, cross sec.; (x 34).
11. *Apluda cristata*, long. sec.; (x 12).
12. *Apluda cristata*, cross sec.; (x 30).
13 A–E. *Anthephora elegans*, long. and cross sec.; (x 17).
14 A–D. *Zoysia pungens*, long and cross sec.; (x 12).
15 A–D. *Perotis latifolia*, long. and cross sec.; (x 17).
16. *Pennisetum spicatum*, long. sec.; (x 12).
17. *Pennisetum spicatum*, cross sec.; (x 16).
18. *Pennisetum spicatum*, cross sec.; (x 28).

PLATE III.

19. *Chætochloa macrochæta*, long. sec.; (x 13).
20. *Paspalum pubiflorum glabrum*, long. sec.; (x 20).
21. *Paspalum pubiflorum glabrum*, cross sec.; (x 12).
22. *Zizania aquatica*, long. sec.; (x 5).
23 A and B. *Zizania aquatica*, cross sec.; (x 10).
24 A–T. *Zizania aquatica*, cross sec. of embryo; (x 6).

PLATE IV.

25. *Lygeum spartum*, long. sec.; (x 6.5).
26 A–E. *Lygeum spartum*, cross sec.; (x 18).
27. *Oryza sativa*, long. sec.; (x 7).
28. *Homalocenchrus oryzoides*, long. sec.; (x 14).
29. *Anthoxanthum odoratum*, long. sec.; (x 23).
30. *Stipa tenacissima*, long. sec.; (x 20).
31. *Stipa tenacissima*, cross sec.; (x 24).
32. *Stipa viridula*, long. sec.; (x 14).
33. *Stipa viridula*, cross sec.; (x 42).
34. *Eriocoma cuspidata*, long. sec.; (x 17).
35. *Eriocoma cuspidata*, cross sec.; (x 43).

Plate V.

Fig. 36. *Stipa richardsonii*, long. sec.; (x 17).
37. A and B. *Stipa richardsonii*, cross sec.; (x 24).
38 A. *Oryzopsis micrantha*, long. and cross sec.; (x 14).
38 B. *Oryzopsis micrantha*, long. and cross sec.; (x 29).
39. *Cinna arundinacea*, long. sec.; (x 10).
40. *Cinna arundinacea*, cross sec.; (x 50).
41. *Phleum pratense*, long. sec.; (x 18).
42. *Ammophila arenaria*, long. sec.; (x 20).
43. *Brachyelytrum erectum*, long. sec.; (x 6).
44. *Avena sativa*, long. sec.; (x 5).
45. *Avena sativa*, long. sec. facing embryo; (x 6).
46 A and B. *Avena sativa*, cross sec.; (x 10).
47 A–G. *Avena sativa*, cross sec. of embryo; (x 13).

Plate VI.

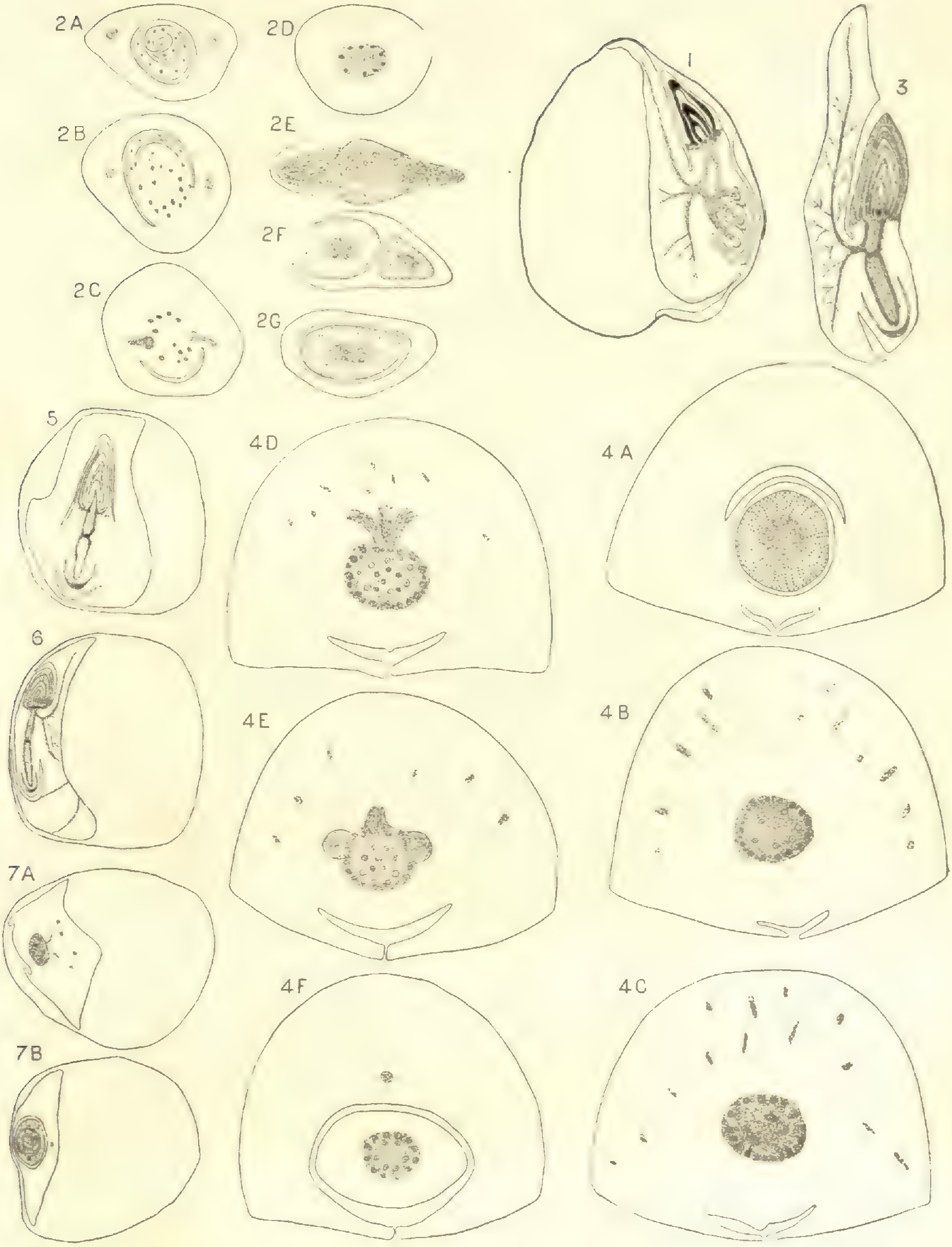
48. *Avena sativa*, long. sec. of embryo; (x 13).
49. *Arrhenatherum elatius*, long. sec.; (x 11).
50. *Danthonia spicata*, long. sec.; (x 17).
51. *Holcus lanatus*, long. sec.; (x 20).
52 A–D. *Eleusine coracana*, long. and cross sec.; (x 13).
53. *Spartina gracilis*, long. sec.; (x 9).
54 A–C. *Spartina gracilis*, cross sec.; (x 16).
55. *Astrebla pectinata*, long. sec.; (x 20).
56. *Leptochloa imbricata*, long. sec.; (x 27).
57. *Cynodon dactylon*, long. sec.; (x 31).
58. *Bulbilis dactyloides*, long. sec.; (x 18).
59. *Bulbilis dactyloides*, cross sec.; (x 18).
60. *Beckmannia erucæformis*, long. sec.; (x 26).

Plate VII.

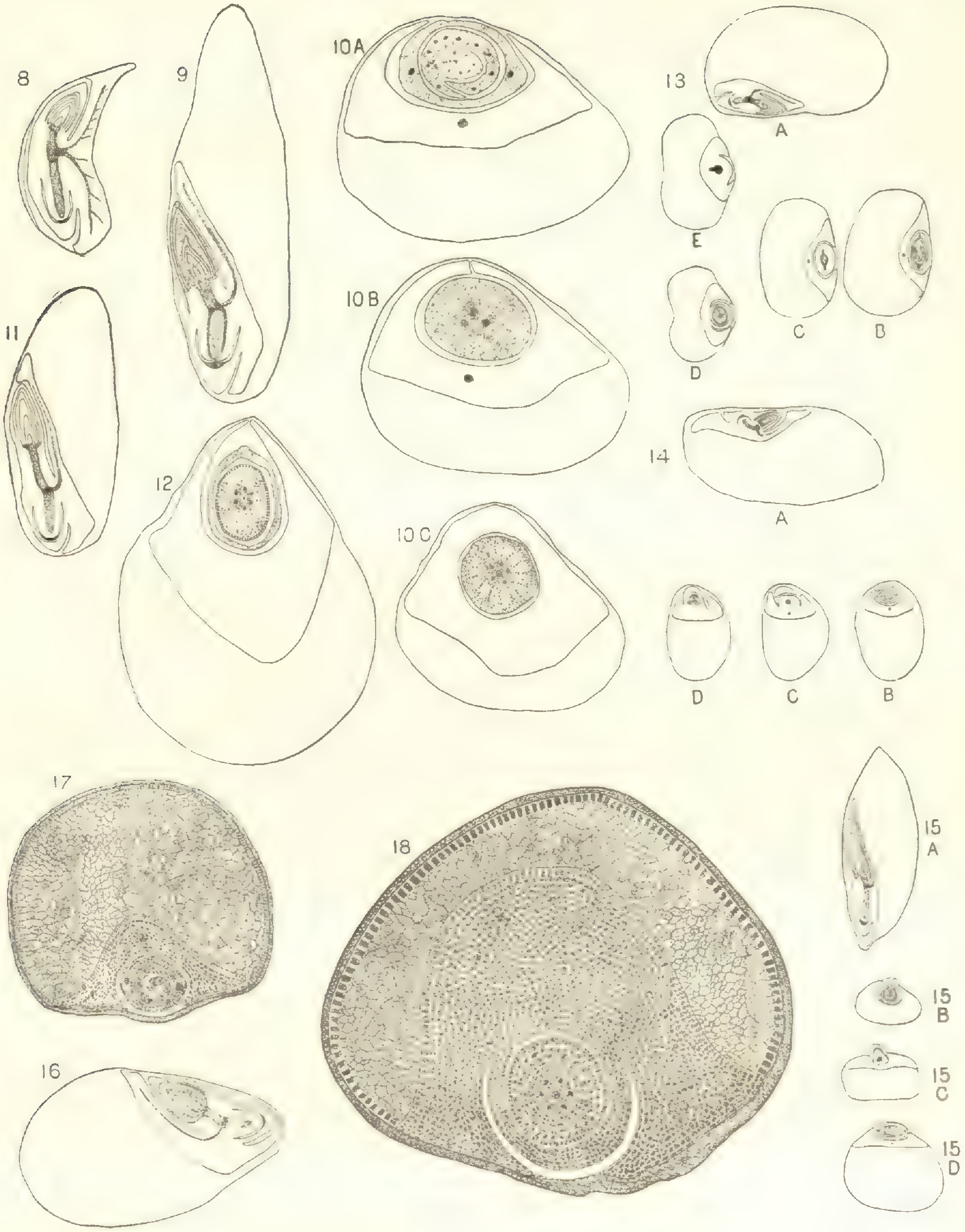
61. *Uniola latifolia*, long. sec.; (x 10).
62. *Panicularia aquatica*, long. sec.; (x 17).
63. *Desmazeria sicula*, long. sec.; (x 17).
64. *Cynosurus cristatus*, long. sec.; (x 16).
65. *Hordeum vulgare*, long. sec. of embryo; (x 9).
66 A–H. *Hordeum vulgare*, cross sec. of embryo; (x 18).
67. *Secale montanum*, long. sec.; (x 15).
68 A and B. *Secale montanum*, cross. sec.; (x 14).
69. *Triticum æstivum*, long. sec. of embryo; (x 13).

Plate VIII.

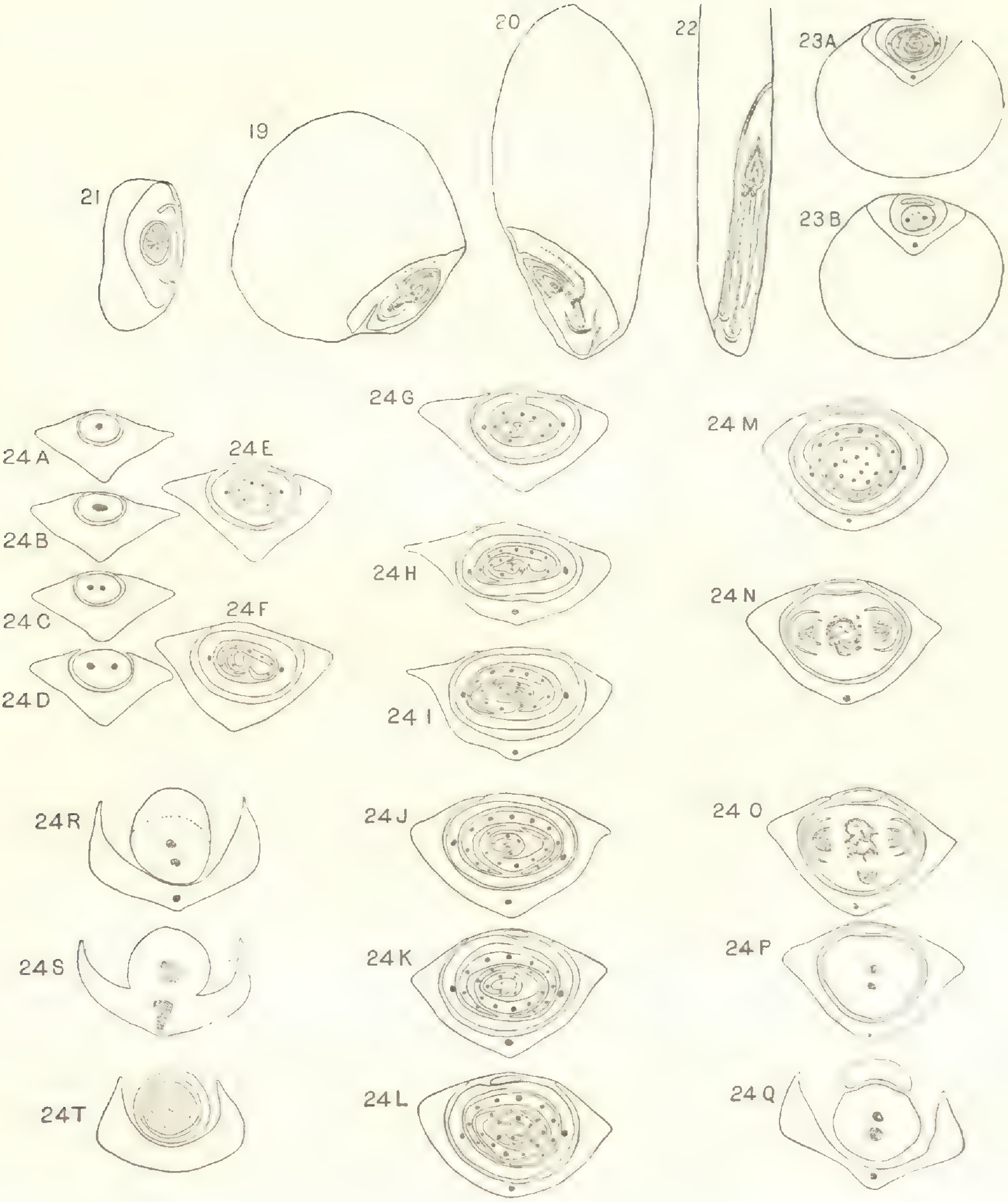
70. *Lolium rigidum*, long. sec.; (x 16).
71 A–C. *Lolium rigidum*, cross sec.; (x 24).
72. *Elymus virginicus*, long. sec.; (x 11).
73. *Elymus virginicus*, cross sec.; (x 32).
74. *Arundinaria falcata*, long. sec. of embryo parallel to scutellum; (x 19).
75. *Arundinaria falcata*, long. sec. of embryo; (x 16).
76 A–K. *Arundinaria falcata*, cross sec. of embryo; (x 29).



STRUCTURE OF THE CARYOPSIS OF GRASSES.



STRUCTURE OF THE CARYOPSIS OF GRASSES.



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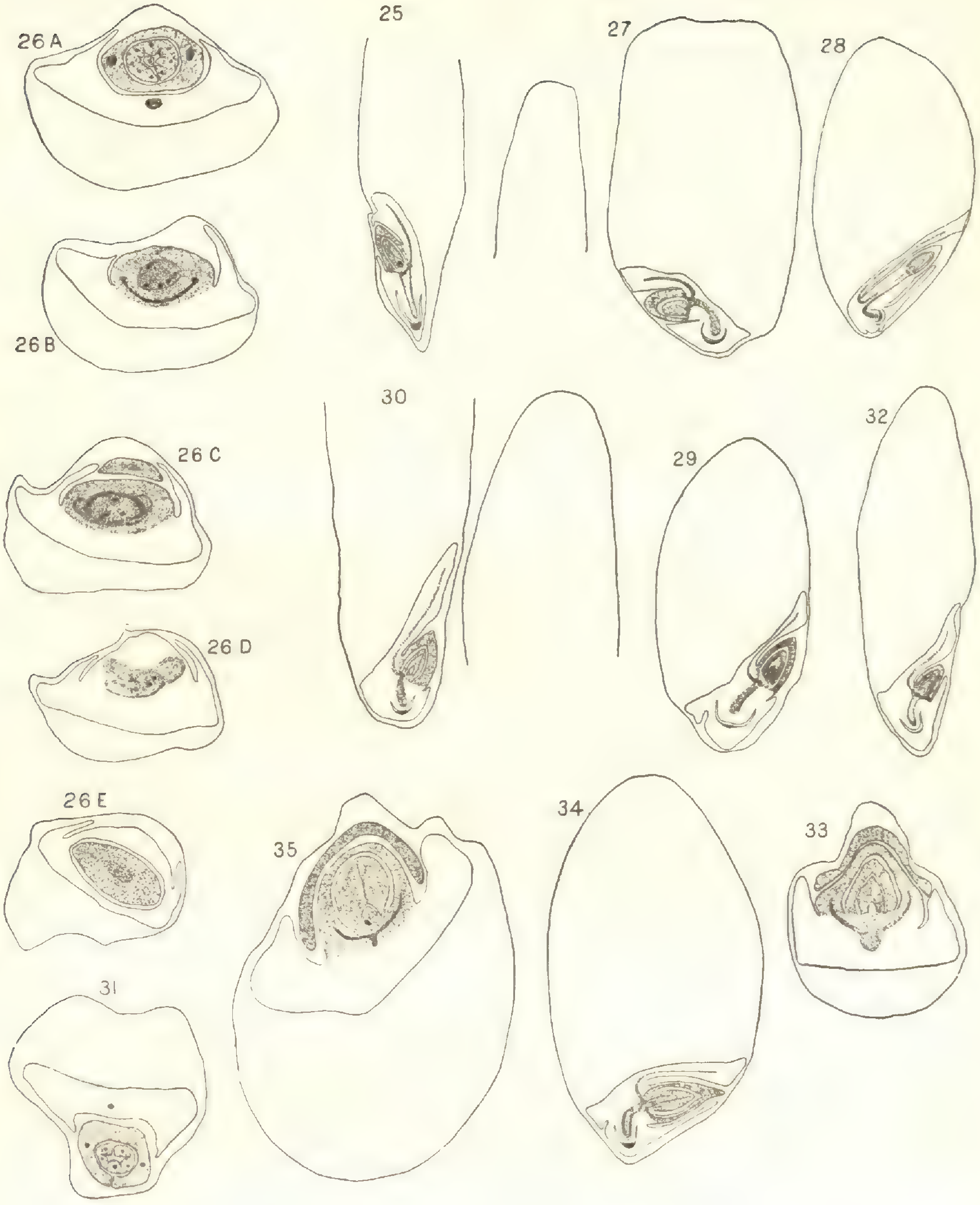

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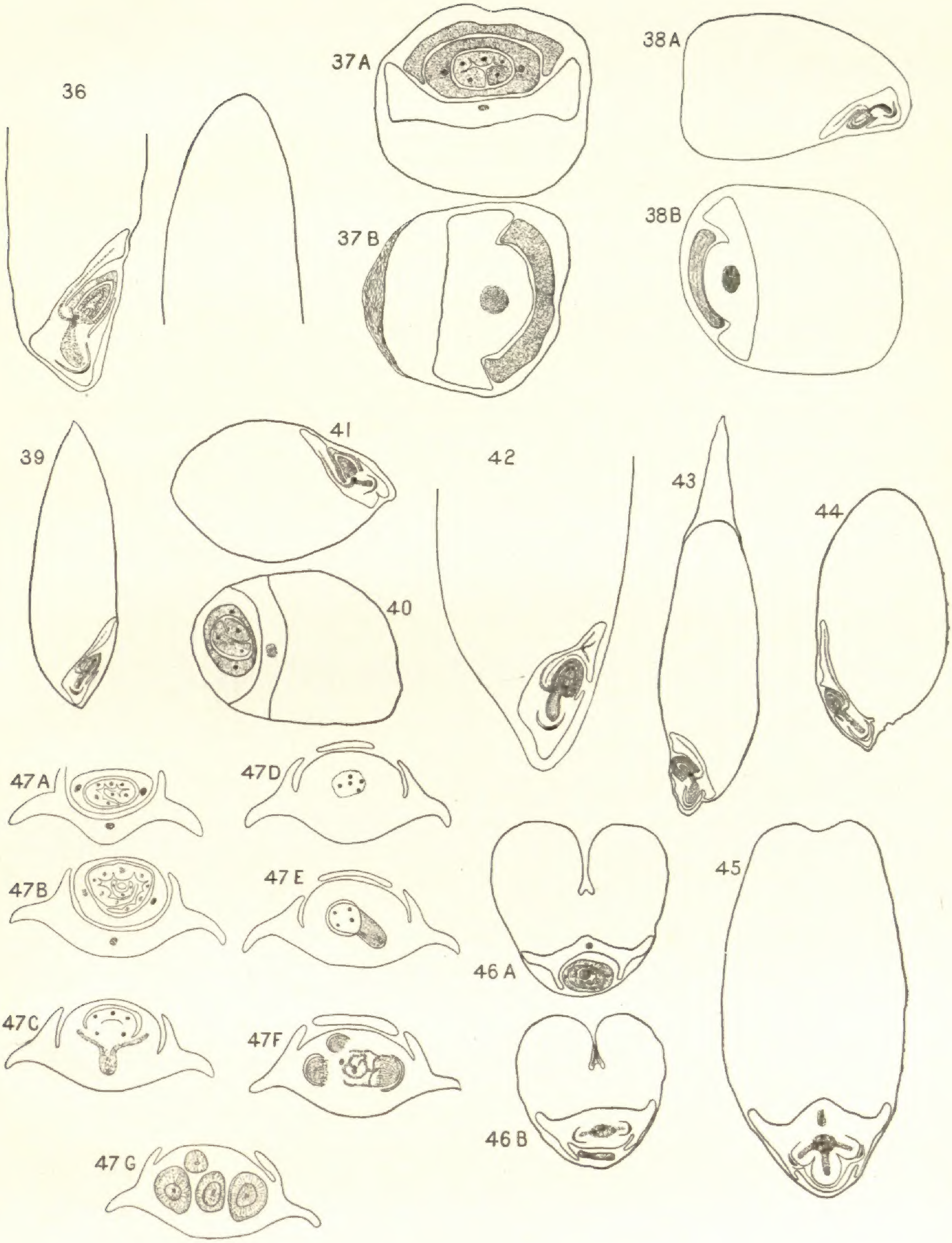

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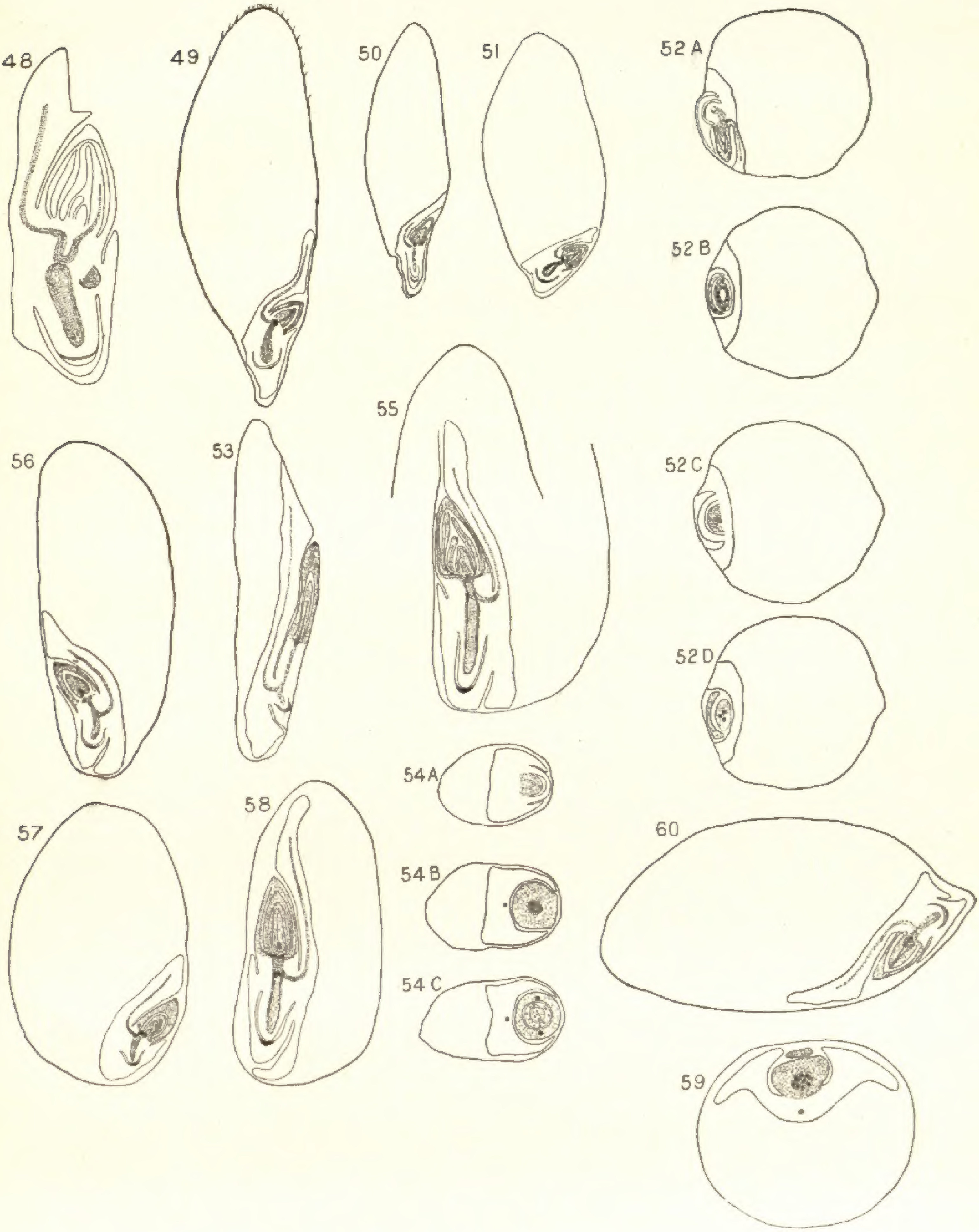

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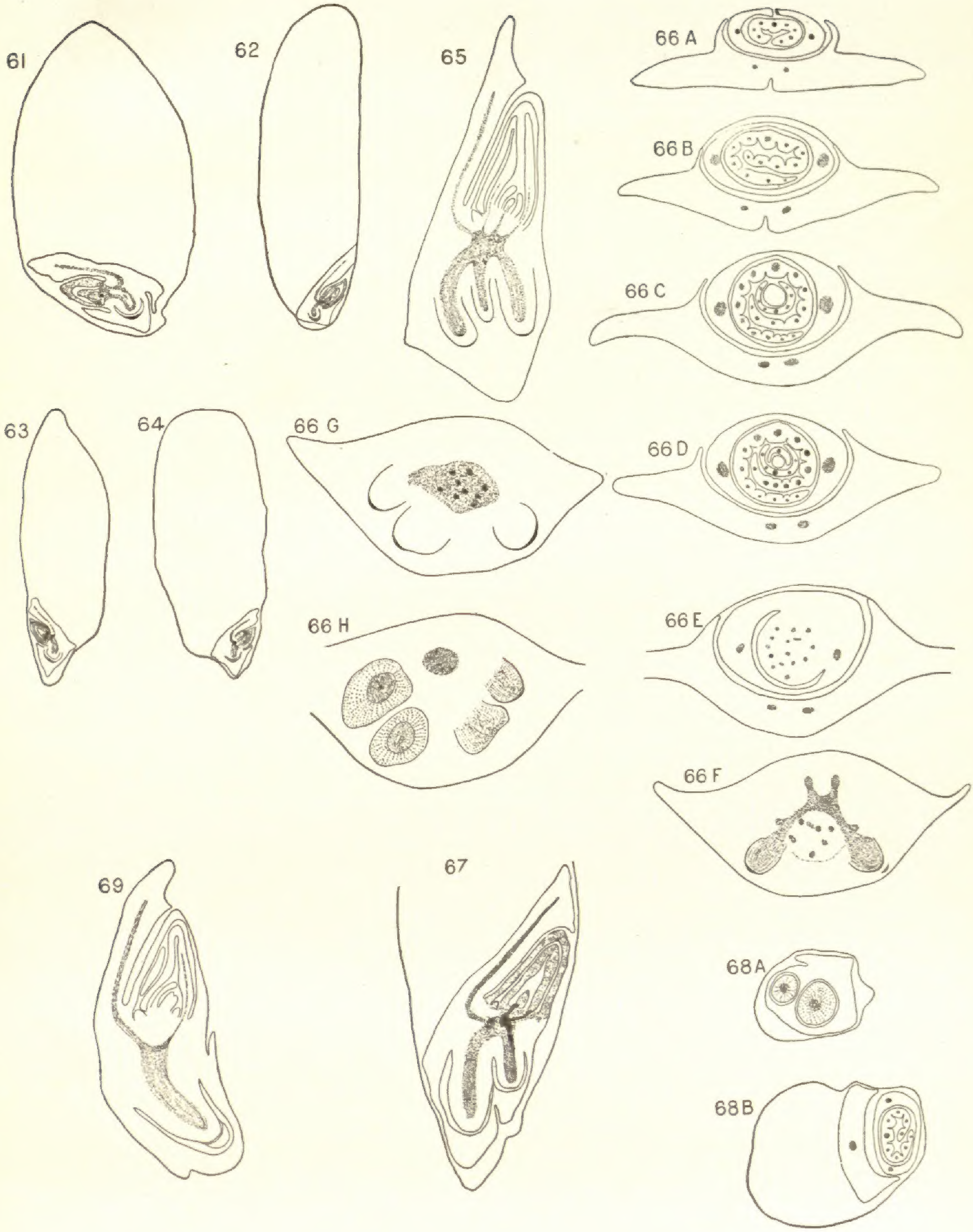

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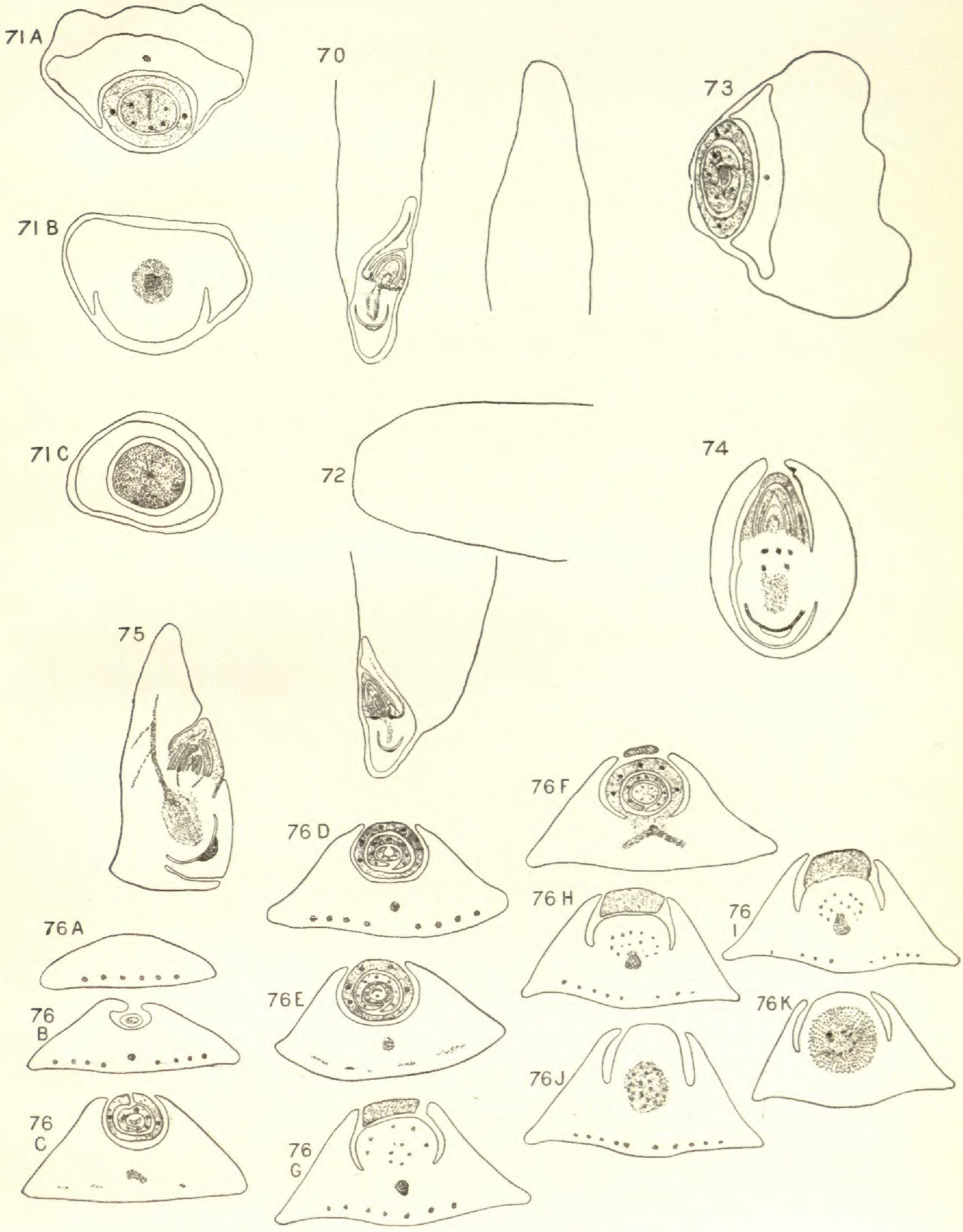

STRUCTURE OF THE CARYOPSIS OF GRASSES.